12. DETAILED ANALYSIS OF ALTERNATIVES

This section presents the detailed analysis of candidate remedial action alternatives developed in Section 11. Results of this analysis will form the basis for future activities such as identification of a preferred alternative for the sites and preparation of the Proposed Plan. Subsequent to appropriate review and comment of the Remedial Investigation and Feasibility Study (RI/FS) and the Proposed Plan, the detailed analysis will support the final selection of remedial actions for the Operable Unit (OU) 1-10 sites and preparation of the Record of Decision (ROD).

12.1 Introduction

The detailed analysis provides an evaluation of candidate alternatives with respect to the nine evaluation criteria specified in 40 Code of Federal Regulations (CFR) 300.430(e)(9)(iii). The nine evaluation criteria consist of:

1. Overall protection of human health and the environment
2. Compliance with applicable and relevant and appropriate requirements (ARARs)
3. Long-term effectiveness and permanence
4. Reduction of toxicity, mobility, or volume through treatment
5. Short-term effectiveness
6. Implementability
7. Cost
8. State acceptance
9. Community acceptance.

These nine evaluation criteria form the basis for conducting the detailed analysis. This analysis presents sufficient information to allow decision makers [i.e., Department of Energy Idaho Operations Office (DOE-ID), Environmental Protection Agency (EPA), and Idaho Department of Health and Welfare (IDHW)] to select an appropriate remedy for the OU. Evaluation against the nine criteria is the basis for determining the ability of a remedial action alternative to satisfy Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) remedy selection requirements.

The detailed analysis includes an assessment of each alternative individually against each of the criteria except State and Community acceptance. In accordance with CERCLA guidance, these final two criteria will be evaluated following comment on the RI/FS report and the Proposed Plan (EPA 1988). The two criteria will be addressed during selection of a remedy and while the ROD is being prepared (EPA 1988). Results of the individual analysis are then used in a comparative analysis which identifies advantages and disadvantages of the alternatives relative to one another.

A description of the nine evaluation criterion outlined is presented below.

12.1.1 Overall Protection of Human Health and the Environment

Alternatives shall be assessed to determine whether they can adequately protect human health and the environment, in both the short and long term, from unacceptable risks posed by hazardous substances, pollutants, or contaminants present at OU 1-10 by eliminating, reducing, or controlling exposures to levels established during the development of remediation goals consistent with 40 CFR 300.430(e)(2)(i). Overall protection of human health and the environment draws on the assessments of other evaluation criteria, especially long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs.

12.1.2 Compliance with ARARs

The alternatives shall be assessed to determine whether they meet ARARs under Federal environmental laws and State environmental or facility siting laws or provide grounds for invoking one of the waivers in 40 CFR 300.430(f)(1)(ii)(C). A list of ARARs identified for WAG 1 and the release site groups to which the ARARs apply is presented in Table 12-1.

12.1.3 Long-Term Effectiveness and Permanence

Alternatives shall be assessed for the long-term effectiveness and permanence they provide, along with the degree of certainty that the alternative would be successfully implemented. Factors considered under this criteria include:

- Magnitude of residual risk remaining from untreated waste or treatment residuals remaining at the conclusion of the remedial activities. Characteristics of residuals are considered to the degree that they remain hazardous, taking into account their volume, toxicity, mobility, and propensity to bioaccumulate.

- Adequacy and reliability of controls such as containment systems and institutional controls potentially necessary to manage residual and untreated waste treatment. This factor addresses the uncertainties associated with land disposal for providing long-term protection from residuals; the assessment of the potential need to replace technical components of the alternative, such as a cap, slurry wall, or treatment system; and the potential exposure pathways and risks posed should the remedial action need replacement.

12.1.4 Reduction of Toxicity, Mobility, or Volume through Treatment

The degree to which the candidate alternatives employ recycling or treatment that reduces toxicity, mobility, or volume shall be assessed, including how the treatment is used to address the principal threats posed by OU 1-10 sites. Factors considered, as appropriate, include:

- Treatment or recycling processes that the alternatives employ and the materials they will treat

- Amount of hazardous substances, pollutants, or contaminants that will be destroyed or recycled

- Degree of expected reduction in toxicity, mobility, or volume of the waste because of the treatment or recycling and the specification of which reductions are occurring

Table 12-1. Compliance applicable or relevant and appropriate requirements (ARARs) and to be considered controls (TBCs) for Waste Area Group 1 sites.

		Applicability			
Regulation, Statute, or Order	Citation	Mixed Low-Level Contaminated Soil/Sediment	Nonradionuclide-Contaminated Soil/Sediment	V Tanks (TSF-09/18)	PM-2A Tanks (TSF-26)
ARAR					
Idaho Hazardous Waste Management Act	IDAPA 16.01.05.005 (40 CFR 261) IDAPA 16.01.05.006 (40 CFR 262.11) IDAPA 16.01.05.007 IDAPA 16.01.05.008 (40 CFR 264) IDAPA 16.01.05.009 IDAPA 16.01.05.010 IDAPA 16.01.05.011 (40 CFR 268)	✓	✓	✓	✓
Toxic Substances	IDAPA 16.01.01.161	✓	✓	✓	✓
National Pollutant Discharge Elimination System	40 CFR 122.26	✓		✓	✓
Toxic Substances Control—PCBs	40 CFR 761			✓	
PCB Marking Requirements	40 CFR 761.40(a)(1), (a)(9), (a)(10), (e), (h)			✓	
Disposal of Rags, Debris after Remedial Action	40 CFR 761.60(a)(4)			✓	
Disposal of PCB Containers after Remedial Action	40 CFR 761.60(c)			✓	
PCB Spill Cleanup During Remedial Action	40 CFR 761.60(d)			✓	
Storage of PCB Waste	40 CFR 765.65(b) except (b)(v)			✓	
30 Day Storage of PCB Waste During Remedial Action	40 CFR 761.65(b)			✓	
PCB Waste Inspections	40 CFR 761.65(c)(5)			✓	
PCB Container Requirements	40 CFR 761.65(c)(6) and (c)(7)			✓	
Placing a Date on PCB Containers	40 CFR 761.65(c)(8)			✓	
PCB Landfill Technical Requirements	40 CFR 761.75(b)(3), (b)(4), (b)(5), (b)(6)(ii), (b)(6)(iii), and (b)(7)(i)			✓	
PCB Spill Cleanup During Remedial Action	40 CFR 761.125 and .130			✓	✓
Manifesting PCB Waste Offsite	40 CFR 761.207 and .208			✓	✓
Evaluate Federal Projects for Impact to Endangered or Threatened Species or Critical Habitats	50 CFR 402.12	✓			

Table 12-1. (continued).

Regulation, Statute, or Order	Citation	Applicability: Mixed Low-Level Contaminated Soil/Sediment	Nonradionuclide-Contaminated Soil/Sediment	V Tanks (TSF-09/18)	PM-2A Tanks (TSF-26)
Evaluate DOE Projects for Potential Floodplain and Wetland Impact	10 CFR 1022	✓			
Idaho Fugitive Dust Emissions	IDAPA 16.01.01.650 and .651	✓	✓	✓	✓
Hazardous Waste Determination	40 CFR 262.11			✓	✓
Accumulation of Hazardous Waste	40 CFR 262.34(a)(1), (2)(c)(1), and (4)			✓	✓
General Waste Analysis	40 CFR 264.13(a)(1),(a)(2)	✓	✓	✓	✓
Security	40 CFR 264.14	✓	✓	✓	✓
General Inspection	40 CFR 264.15	✓	✓	✓	✓
Personnel Training	40 CFR 264.16	✓	✓	✓	✓
Location Standards	40 CFR 264.18(a)	✓	✓	✓	✓
Preparedness and Prevention	40 CFR Subpart C	✓	✓	✓	✓
Emergency Planning	40 CFR 264 Subpart D except 264.56(j)	✓	✓	✓	✓
Operating Record	40 CFR 264.73, except 264.73(b)(8)	✓	✓	✓	✓
Miscellaneous Units	40 CFR Subpart X	TBD	TBD	TBD	TBD
Land Disposal Restrictions for Secondary Waste	40 CFR 268.7, 9, .40, .45, .48				
Rules for Solid Waste Management	IDAPA 16.01.06.004		✓		
Flood Plains	40 CFR 257.3-1(a)		✓		
Groundwater	40 CFR 257.3-4(a)		✓		
Idaho Water Quality	IDAPA 16.01.02.299(5)(a) and (b)	✓	✓	✓	✓
Idaho Ground Water Quality Rule	IDAPA 16.01.11.200	✓	✓	✓	✓
Container Standards	40 CFR 264 Subpart I except .179			✓	✓
New Tanks Systems	40 CFR 264.192 (except certifications will not be submitted)			✓	✓
Containment and Detection of Releases	40 CFR 264.193			✓	✓
General Operating Requirements	40 CFR 264.194			✓	✓
Inspections	40 CFR 264.195			✓	✓
Response to Spills and Leaks	40 CFR 264.196			✓	✓

Table 12-1. (continued).

Regulation, Statute, or Order	Citation	Applicability: Mixed Low-Level Contaminated Soil/Sediment	Nonradionuclide-Contaminated Soil/Sediment	V Tanks (TSF-09/18)	PM-2A Tanks (TSF-26)
Closure	40 CFR 264.197(a) and (b)			✓	✓
Incompatible Waste	40 CFR 264.199			✓	✓
Requirements for Portable Equipment	IDAPA 16.01.01.500.02	✓	✓	✓	✓
NESHAPS—Mercury	40 CFR 61.52(b)			✓	
Mercury Emissions Testing	40 CFR 61.53(d), .54			✓	
Mercury Emissions Monitoring	40 CFR 61.55			✓	
Ground Water Protection Standard	40 CFR 264.92		✓	✓	✓
Hazardous Constituents	40 CFR 264.92		✓	✓	✓
Point of Compliance	40 CFR 264.93		✓	✓	✓
Ground Water Monitoring Requirements	40 CFR 264.97		✓	✓	✓
Detection Monitoring Program	40 CFR 264.98(a), (b), (c), (d), (e), and (f)		✓	✓	✓
Closure Performance Standards	40 CFR 264.111(a) and (b) and .114			✓	✓
Closure and Post Closure	40 CFR 264.310(a)(1), (2), (3), (4), (5); (b)(1) , (4), (5), (6)		✓	✓	✓
Surveying and Record Keeping	40 CFR 264.309(a) and (b)		✓	✓	✓
Assessment of Existing Tank Systems	40 CFR 264.191(a), (b), and (d)			✓	✓
Preconstruction Compliance with Toxic Standards	IDAPA 16.01.01.210				
NESHAPS—Radionuclide Emissions from DOE facilities (other than Radon-222 and Radon-220 at DOE Facilities-Emission Standard)	40 CFR 61.92	✓	✓	✓	✓
Emission Monitoring	40 CFR 61.93	✓	✓	✓	✓
Emission Compliance	40 CFR 61.94			✓	✓
Rules for the Control of Air Pollution in Idaho (Air Toxins Rules) Toxic Air Emissions	IDAPA 16.01.01585 and 16.01.01586	✓	✓	✓	✓
Landmarks, Historical, and Archeological Sites	40 CFR 6.301	unlikely	unlikely	unlikely	unlikely
Migratory Bird Conservation	16 USC 715	✓			

Table 12-1. (continued).

Regulation, Statute, or Order	Citation	Applicability: Mixed Low-Level Contaminated Soil/Sediment	Nonradionuclide-Contaminated Soil/Sediment	V Tanks (TSF-09/18)	PM-2A Tanks (TSF-26)
Requirements for Land Disposal of Radioactive Waste	10 CFR 61	✓		✓	✓
Location Standards	40 CFR 264.18(a)	✓	✓	✓	
Preparedness and Prevention	40 CFR Subpart C	✓	✓	✓	
Emergency Planning	40 CFR 264 Subpart D, except 264.56(j)	✓	✓	✓	
Operating Record	40 CFR 264.73, except 264.73(b)(8)	✓	✓	✓	
National Historic Preservation Act	16 USC 470 et seq.	✓	✓	✓	✓
Storm Water Discharges	40 CFR 122.26	✓	✓	✓	✓
To be considered (TBC)					
Environmental Protection, Safety, and Health Protection Standards	DOE Order 5480.4	✓	✓	✓	✓
Radioactive Waste Management	DOE Order 5820.2A	✓	✓		✓
Radiation Protection of the Public and Environment	DOE Order 5400.5	✓	✓		✓
Hazardous and Mixed Waste Program	DOE Order 5400.3		✓	✓	✓
Environmental Protection, Safety and Health Protection Standard	DOE Order 5480.4	✓	✓	✓	✓
Residual Radioactive Material in Soil	DOE Order 5400.5, Chapter IV	✓		✓	✓
Low Level Radioactive Waste Management	DOE Order 5820.2A, Chapter III	✓		✓	✓
General Design Criteria	DOE Order 6430.1A			✓	✓

a. ARAR waivers will be required for Waste Area Group 1 as indicated below.

Regulation	Citation	Waiver
Incineration of Mineral Oil PCB Waste	40 CFR 761.60(a)(1)	Waste with contamination at > 500 ppm will be treated by grouting rather than by the required technology of incineration with 99.9999% destruction.
Incineration of Nonmineral Oil PCB Waste	40 CFR 761.60((a)(3)(i))	Waste with contamination at > 500 ppm will be treated and disposed of by grouting rather than by the required technology of incineration with 99.9999% destruction.

Table 12-1. (continued).

Regulation, Statute, or Order	Citation	Applicability: Mixed Low-Level Contaminated Soil/Sediment	Nonradionuclide-Contaminated Soil/Sediment	V Tanks (TSF-09/18)	PM-2A Tanks (TSF-26)
Chemical Waste Landfill Required for Mineral Oil	40 CFR 761.60(a)(2)(ii)	Waste with contamination between 50 and 500 ppm PCBs will be treated and disposed of by grouting rather than the allowed alternatives of disposal in a Toxic Substances Control Act (TSCA) -permitted chemical waste landfill, combustion in a TSCA-approved boiler, chemical dehalogenation by the sodium/glycol method, or incineration in a TSCA-approved incinerator.			
Chemical Waste Landfill for Liquid PCBs Other Than Mineral Oil	40 CFR 761.60(a)(3)(ii)	Waste with contamination between 50 and 500 ppm PCBs will be treated and disposed of by grouting rather than by the allowed alternatives of disposal in a TSCA-permitted chemical waste landfill, combustion in a TSCA-approved boiler, chemical dehalogenation by the sodium/glycol method, or incineration in a TSCA-approved incinerator.			
PCB Storage in 100-Year Flood Plain	40 CFR 761.65(b)(v)	Waste contaminated with > 50 ppm PCBs will be land disposed of in the Birch Creek 100-year flood plain.			
RCRA Location Standards	40 CFR 264.18(b)	Hazardous and mixed waste will be land disposed of in the Birch Creek 100-year flood plain (unless delisting occurs in the Record of Decision).			
Land Disposal Restriction (LDR)-required Technology for High Mercury Waste If Placement Occurs	40 CFR 268.40	If V tank waste is removed from the tank for grouting, then placement has occurred and the LDR technology standard of incineration and retorting for high mercury waste will apply. Grouting will not achieve the standard.			

- Degree to which the treatment is irreversible
- Type and quantity of residuals that will remain following treatment, taking into consideration the persistence, toxicity, mobility, and propensity to bioaccumulate of such hazardous substances and their constituents
- Degree to which treatment reduces the inherent hazards posed by the principal threats at OU 1-10 sites.

12.1.5 Short-Term Effectiveness

The short-term impacts of the implementation period for each of the alternatives shall be assessed considering the following criteria:

- Short-term risks that might be posed to the community during implementation of an alternative
- Potential impacts to workers during remedial action, and the effectiveness and reliability of protective measures
- Potential environmental impacts of the remedial action and the effectiveness and reliability of mitigative measures during implementation
- Time until protection is achieved.

12.1.6 Implementability

The ease or difficulty of implementing the alternatives is assessed by considering the following:

- Technical feasibility, including the technical difficulties and unknown conditions associated with the construction and operation of the alternative, reliability of the technology, ease of undertaking additional remedial actions, and ability to monitor the effectiveness of the remedy
- Administrative feasibility, including activities required to coordinate with other offices and agencies, and the ability and time needed to obtain necessary approvals and permits from other agencies (for offsite actions)
- Availability of services and materials, including the availability of adequate offsite treatment, storage capacity, and disposal capacity and services; availability of necessary equipment and specialists, and provision to ensure any necessary additional resources; availability of services and materials; and availability of prospective technologies.

12.1.7 Cost

Costs assessed for each alternative include the following:

- Federal Facility Agreement/Consent Order (FFA/CO) management and oversight costs, which would be incurred primarily by the Idaho National Engineering and Environmental Laboratory (INEEL) Environmental Restoration (ER) Program
- Cleanup costs, including construction management and oversight, Remedial Design/Remedial Action (RD/RA) document preparation, and reporting costs
- Remedial design costs
- Construction costs, including General and Administrative (G&A) and construction subcontract fees
- Operations costs
- Surveillance and monitoring costs.

All Life Cycle Costs have been initially presented in constant fiscal year (FY) 97 dollars. Escalation has been applied as directed by Department of Energy (DOE) Order 430.1, "Life-Cycle Asset Management." Guidance has been provided by DOE-Headquarters, Office of Project and Fixed Asset Management, "Departmental Price Change Index, FY 1999 Guidance, Anticipated Economic Escalation Rates," January 1997 Update. Escalation rates have been provided through FY 2003, and outyear calculations utilize a constant FY 2003 rate. Finally, Net Present Value (NPV) reflects a total for both the Capital Cost and Operations and Maintenance. NPV dollars have been escalated and discounted at a 5% discount as recommended by EPA (1988).

NPV dollars are presented for each alternative. The alternative cost estimates are for comparison purposes only and are not intended for budgetary, planning, or funding purposes. Estimates have a range of accuracy of +50% to −30%, in accordance with CERCLA (EPA 1988) guidance. Summary Cost Estimate sheets as well as the general methodology, assumptions, and derivations of alternative cost estimates are provided in Appendix J.

12.1.8 State Acceptance

Assessment of State concerns can not be completed until comments on the RI/FS are received but will be discussed, to the extent possible, in the Proposed Plan issued for public comment.

12.1.9 Community Acceptance

This assessment includes determining which components of the alternatives interested persons in the community support, have reservations about, or oppose. The assessment of community acceptance will be completed through comments on the Proposed Plan.

12.2 Individual Analysis of Alternatives for Radionuclide-Contaminated Sites

In accordance with RI/FS guidance, candidate remedial action alternatives retained for detailed analysis are individually assessed against the evaluation criteria listed in Section 12.1, not including state and community acceptance. The individual analysis of each alternative developed to address Cs-137 contamination at Technical Support Facility TSF-06 (Area B) and TSF-07, and Ra-226 contamination at TSF-07 is presented in the following subsections.

12.2.1 Alternative 1: No Action/Limited Action

The No Action/Limited Action alternative is presented to comply with requirements of the National Contingency Plan (NCP) [40 CFR 300.430 (e)(6)] and guidance for conducting feasibility studies (FSs) under CERCLA (EPA 1988). The No Action/Limited Action alternative provides a baseline with which other alternatives can be compared. Limited activities would be included as part of this alternative and would consist of the continuation of ongoing INEEL site wide environmental monitoring under the Radiological Environmental Surveillance Program (RESP) and Site Environmental Surveillance Program (SESP), the maintenance of existing institutional controls at OU 1-10 sites, and potential expansion of environmental monitoring and institutional controls to accommodate site-specific concerns as required. Monitoring activities may consist of the collection and analysis of air, groundwater, soil, biota, and other media from the site as applicable. Air monitoring may include the use of high- and low-volume air samplers to determine if fugitive radionuclides escape sites where contaminated surface soils exist. Groundwater monitoring may include monitoring contaminant migration in groundwater beneath the site. Soil monitoring would include radiation surveys over and around sites where contaminated soil and debris are left in place, to evaluate if radionuclides have been mobilized to the surface.

Institutional controls would consist of restricting access to the subsites by using controls such as fencing and legal restrictions. In addition, five-year site reviews would be conducted to evaluate the effectiveness of the institutional controls and the need for further environmental monitoring, or additional control measures, as applicable. Five-year site reviews would be conducted for a duration of 100 years. The details associated with implementation of this alternative for TSF-06 (Area B) and TSF-07 are discussed in the following paragraphs.

At TSF-06 (Area B), environmental monitoring would be continued. Current management practices such as restricting activities without clearance from the INEEL ER directorate would also be continued. A perimeter security fence with appropriate signage would be installed around the entire extent of the contamination on both sides of Snake Avenue. The estimated footprint of contamination at TSF-06 (Area B) is approximately 165 to 30 m (540 to 100 ft).

At TSF-07, environmental monitoring would be continued. Current management practices such as restricting activities conducted at TSF-07 without clearance from the INEEL ER directorate would also be continued. A perimeter security fence with appropriate signage would be installed around the entire extent of contamination including the main pond. The estimated footprint of contamination at TSF-07 is approximately 192 to 30 m (630 to 100 ft). Surface water diversion controls would be implemented to prevent storm-water runoff from entering the pond.

12.2.1.1 Overall Protection of Human Health and the Environment. Under the No Action/Limited Action alternative, human health and environmental risks would be reduced since direct exposure to radionuclides in soils at TSF-06 (Area B) and TSF-07 would be minimized. Therefore, continuation of environmental monitoring, installation of a perimeter security fence and imposing access restrictions meet specified remedial action objectives (RAOs) at these subsites.

12.2.1.2 Compliance with ARARs and TBCs. Table 12-1 presents the evaluation of the No Action/Limited Action alternative for compliance with identified ARARs and to-be-considereds (TBCs). While this alternative does not involve any construction or operational activities that would result in disturbances to the surfaces of TSF-06 (Area B) and TSF-07, Idaho Air Pollution Act (IDAPA) 16.01.01650 could nonetheless apply to the sites if they were a source of fugitive dust. However, modeled results from the baseline risk assessment (BRA) indicate that this ARAR would be met (i.e., risk from the air pathway is acceptable). IDAPA 16.01.01161 would also be met by this alternative. 40 CFR 122.26, regulating stormwater and associated discharges, would apply and is considered an ARAR that would be met through use of engineering controls. This alternative would not meet DOE Orders 5480.4, 5820.2A, or 5400.5 because health risks to potential future workers and residents would not be controlled.

12.2.1.3 Long-Term Effectiveness and Permanence. The No Action/Limited Action alternative provides for long-term control of human and environmental exposure to contaminated soils at the TSF-06 (Area B) and TSF-07 sites. However, the permanence of the reduction in risk is limited to the institutional control period. Because residual risk associated with contaminated soil and debris would remain under this alternative, the long-term effectiveness and permanence of the No Action/Limited Action alternative is considered moderate.

12.2.1.4 Reduction of Toxicity, Mobility, or Volume Through Treatment. No treatment is associated with this alternative. Toxicity, mobility, and volume of contaminated materials would remain unchanged.

12.2.1.5 Short-Term Effectiveness. This alternative can be readily implemented without additional risks to the community, workers, or the environment. No specialized equipment, personnel, or services are required to implement the No Action/Limited Action alternative. Because of this the short-term effectiveness is ranked high.

12.2.1.6 Implementability. This alternative is technically feasible and has a moderate administrative feasibility. There are no site-specific conditions that exist at the subsites that would inhibit environmental monitoring or perimeter security fence installation activities. However, long-term management and monitoring of the sites would be required. Although not anticipated, if opposition to access restrictions were met, gaining approval could be administratively difficult. Equipment and materials required for implementation of this alternative are readily available. Implementability of the No Action/Limited Action alternative is considered high.

12.2.1.7 Cost. The costs associated with the No Action/Limited Action alternative include installation of a perimeter security fence, installation of surface water diversion controls, imposing legal land-use restrictions, conducting periodic monitoring activities, and, for costing purposes, conducting five-year site reviews for a period of 100 years. Post-closure costs were estimated for a 100-year monitoring period. The estimated NPV for each subsite is shown in Table 12-2. The alternative cost estimates are for comparison purposes only and not intended for budgetary, planning or funding purposes.

12.2.2 Alternative 2a: Native Soil Cover

The native soil cover for OU 1-10 radioactive-contaminated sites is intended to provide 3 m (10 ft) of clean INEEL native soils placed over areas with soil concentrations exceeding primary remediation goal (PRGs). Alternative 2a would not be implementable for TSF-06 (Area B) due to the presence of impacted soils adjacent to, and beneath Snake Avenue. The segment of Snake Avenue located in the vicinity of TSF-06 (Area B) could not be rebuilt on top of the cover and cannot be relocated. As a result, placement of a native soil cover over this area is not a viable option. Implementing this alternative at TSF-07 would consist of adding soil layers above grade to bring the total thickness of "clean" soils above the contaminated soils to 3 m (10 ft). The native soil cover would be constructed with a top slope of 2% and integrated into the natural surrounding grade with a 4:1 slope constructed at the edge of the 3 m (10 ft) soil cover. The surface of the soil cover would be vegetated with a crested wheatgrass to limit infiltration and erosion. Site-specific considerations would be used to design the optimum configuration for application at TSF-07 during the remedial design phase.

During the placement of backfill materials and the lowermost layers of the cover, conventional earth-moving equipment, modified with positive pressure ventilation system cabs and high-efficiency particulate air (HEPA) filters for use in radioactively-contaminated areas, may be used as required.

Emplacement of clean fill and the lowermost layers of the cover would most likely provide enough shielding to allow for the use of conventional earth-moving equipment for remaining construction activities. Throughout the duration of construction, surface water controls would be used.

Environmental monitoring (air, soil, and groundwater, as applicable), and cover integrity monitoring and maintenance (repairing any observable degradation including cracks, erosion, biotic intrusion, etc.) would be conducted on an annual basis as part of this alternative. Current management practices such as restricting activities conducted at TSF-07 without clearance from the INEEL ER directorate would be

Table 12-2. Alternative 1: NPV for TSF-06 (Area B) and TSF-07.

Site	NPV($)
TSF-06 (Area B)	1,479,803
TSF-07	1,633,790

continued. Security fencing, signage, and legal land-use restrictions would also be implemented. Five-year site reviews would be conducted to evaluate the effectiveness of the native soil cover and the need for additional environmental monitoring or control requirements, as necessary. Five-year site reviews would be conducted for a duration of 100 years.

At TSF-07, the native soil cover and revegetation would be placed over the extent of the TSF-07 main disposal pond. The extent of contamination at TSF-07 is estimated to be approximately 192 × 30 m (630 × 100 ft). The fill material of the native soil cap will match the existing elevation of the berm surrounding the pond.

12.2.2.1 Overall Protection of Human Health and the Environment. This alternative is expected to be protective of human health and the environment for TSF-07. Providing 3 m (10 ft) of clean soil above contaminated areas combined with environmental monitoring and access restrictions would prevent direct exposure to radionuclides in soil at TSF-07. The thickness of this barrier would be more than sufficient to shield against penetrating radiation above background levels. Therefore, this alternative meets specified RAOs.

12.2.2.2 Compliance with ARARs. Table 12-1 presents the evaluation of the Native Soil Cover alternative for compliance with identified ARARs and TBCs. Compliance with the emissions control ARARs is ensured by performing excavation using water sprays and other techniques for dust suppression, as needed. Engineering controls for surface water runoff would insure compliance with 40 CFR 122.26, which regulates stormwater and associated discharges. Alternative 2a would meet TBCs including DOE Orders. DOE Orders would be met by implementing and enforcing applicable provisions of the Orders. Therefore, this alternative is capable of complying with all potential ARARs and TBCs identified.

12.2.2.3 Long-Term Effectiveness and Permanence. Providing 3 m (10 ft) of "clean" soils above contaminated areas and restricting activities conducted at TSF-07 is expected to reduce risks associated with potential direct exposure to radionuclides by limiting direct contact with contaminated soils. Continued environmental monitoring, annual inspections and cover maintenance activities (if required), would be conducted to monitor the long-term effectiveness and permanence of this alternative. In addition, five-year site reviews would be conducted for a period of 100 years. Therefore, this alternative would likely provide for long-term and permanent reduction in risks associated with direct exposure to radionuclides in soil at TSF-07.

12.2.2.4 Reduction of Toxicity, Mobility, or Volume Through Treatment. This alternative does not involve treatment of contaminated soils. There is no reduction of toxicity or volume with this alternative. Mobility of contaminants would be reduced with the proposed cover.

12.2.2.5 Short-Term Effectiveness. Exposure to radionuclides in soil during installation of the native soil cover would be minimized by the use of appropriate personal protective equipment, engineering controls, and adherence to INEEL health and safety protocols. During the placement of backfill materials and the construction of the lowermost layers of the cap earth moving equipment modified with positive-pressure ventilation system cabs and HEPA filters for use in radioactively-contaminated areas may be utilized. Equipment modified for use in radioactively contaminated environments is available at the INEEL from previous remedial actions. If not available onsite, equipment may be supplied by a subcontractor or may be purchased from vendors. However, modification of subcontractor or purchased equipment may be necessary for use in a radioactively-contaminated environment. Emplacement of clean fill material and the lowermost layer(s) of the cover would add sufficient shielding throughout the remainder of construction activities.

Nonexposure risks to workers are also a consideration during consolidation of surface soils (if necessary) and construction of the barriers. These risks result primarily from physical construction hazards, such as vehicle accidents or personal injuries. These hazards can be minimized by implementation of appropriate health and safety measures for earth-moving construction activities. Based on DOE Order 5480.11, construction activities would be performed in accordance with the ALARA approach to radiation protection. RAOs would be achieved by this containment alternative once construction of the barrier is complete since health risk from external exposure to contaminated soils identified in the BRA would be below 1E–04.

Environmental impacts resulting from construction activities would likely be minimal. The remoteness of the site would prevent any impact to the surrounding communities during construction activities. Installation of surface water diversion controls may result in alteration of the nearby terrain. However, the overall impact of these activities is not considered irreparable and would be minimal in the long term. No environmentally sensitive areas such as archaeological or historical sites, wetlands, or critical habitat exist in the vicinity of TSF-07.

12.2.2.6 Implementability. This alternative is technically feasible at TSF-07. Alternative 2a would not be implementable at TSF-06 (Area B) due to the presence of impacted soils adjacent to, and beneath Snake Avenue. The segment of Snake Avenue located in the vicinity of TSF-06 (Area B) cannot be relocated, therefore, placement of a native soil cover over this area is not a viable alternative. The technologies associated with implementation of this alternative at TSF-07 are readily available through previous applications at INEEL. There are no site-specific conditions that exist at TSF-07 that would inhibit installation of the native soil cover, perimeter security fence installation, or prevent annual inspection and environmental monitoring activities. The native soil cover design would likely be easily constructed. No specialized equipment or personnel would be necessary, and competitive bids could be easily obtained since a large number of construction firms are capable of performing the required work. Materials required for construction are anticipated to be available onsite at the INEEL. Clay, silt, and sand form the alluvial deposits in the northern portion of the INEEL could possibly be used to construct the native soil cap.

This alternative is administratively feasible for TSF-07. Long-term monitoring activities, maintenance of the soil cover (as necessary), and conducting five-year site reviews for a period of 100 years would require long-term coordination. However, this is not thought to present significant administrative difficulties.

12.2.2.7 Cost. The cost estimate developed for this alternative is based on constructing the native soil cover, installing a perimeter security fence, performing environmental monitoring and annual inspection and maintenance activities (as necessary), and conducting five-year site reviews for a period of 100 years. Post-closure costs were estimated for a 100-year period of maintenance and monitoring. The estimated NPV for this alternative at TSF-07 is shown in Table 12-3. The alternative cost estimates are for comparison purposes only and not intended for budgetary, planning, or funding purposes.

Table 12-3. Alternative 2a: NPV for TSF-07.

Site	NPV ($)
TSF-07	5,644,533

12.2.3 Alternative 2b: Engineered Barrier

Alternative 2b would consist of the placement of an engineered barrier over the contaminated areas at TSF-07. Alternative 2b is not implementable for TSF-06 (Area B) soils due to the presence of impacted soils adjacent to, and underneath, Snake Avenue. The segment of Snake Avenue located within TSF-06 could not be rebuilt on top of the completed cap and cannot be relocated, therefore, placement of an engineered barrier over this area is not considered to be a viable alternative.

The engineered barrier would be designed in accordance with the specifications developed for the closure cover constructed at the SL-1 site at the INEEL. The SL-1 cover consists of a 31-cm (12-in) layer of basalt cobbles underlain and overlain by 20-cm (8-in) layers of gravel, covered with a basaltic rip-rap. The basaltic rip-rap layer would be a minimum of 61 cm (24 in) thick. The side slopes of the cap would be constructed at no greater than a 4:1 slope and brought to natural grade surrounding the site. A perimeter security fence with appropriate signage would be installed around the extent of the native soil cover and side slopes.

During the placement of backfill materials and the lowermost layers of the cap, conventional earth-moving equipment, modified with positive pressure ventilation system cabs and HEPA filters for use in radioactively-contaminated areas, may be used as required. Emplacement of clean fill and the lowermost layers of the cover would most likely provide enough shielding to allow for the use of conventional earth-moving equipment for remaining construction activities. Throughout the duration of construction, surface water controls would be used.

Environmental monitoring (air, soil, and groundwater, as applicable), and cap integrity monitoring and maintenance (repairing any observable degradation including cracks, erosion, biotic intrusion, etc.) would be conducted on an annual basis as part of this alternative. Access restrictions would also be implemented. Current management practices such as restricting activities conducted at TSF-06 without clearance from the INEEL ER directorate would be continued. Five-year site reviews would be conducted to evaluate the effectiveness of the native soil cover and the need for additional environmental monitoring or control requirements, as necessary. Five-year site reviews would be conducted for a duration of 100 years.

At TSF-07, an engineered barrier would be placed over the TSF-07 main disposal pond and diversion ditch. The extent of contamination at TSF-07 is estimated to be approximately 192 × 30 m (630 × 100 ft).

The pond and drainage ditch would be filled with approximately 3.4 m (11 ft) of clean soils to grade prior to construction of the cap to ensure proper drainage.

12.2.3.1 Overall Protection of Human Health and the Environment. This alternative is expected to be protective of human health and the environment at TSF-07. The engineered barrier ensures long-term protection by use of natural construction materials approximately 1.2 m (4 ft) thick. The cap would reduce risks associated with potential direct exposure to radionuclides by limiting direct contact with contaminated soils. The thickness of this barrier would be more than sufficient to shield against penetrating radiation above background levels. Therefore, this alternative meets specified RAOs.

12.2.3.2 Compliance with ARARs. Table 12-1 presents the evaluation of the Engineered Barrier alternative for compliance with identified ARARs and TBCs. Compliance with the emissions control ARARs is ensured by performing excavation using water sprays and other techniques for dust suppression, as needed. Engineering controls for surface water runoff would insure compliance with 40 CFR 122.26

which regulates stormwater and associated discharges. Alternative 2b would meet TBCs including DOE Orders. DOE Orders would be met by implementing and enforcing applicable provisions of the Orders. Therefore, this alternative is capable of complying with the potential ARARs and TBCs identified.

12.2.3.3 Long-Term Effectiveness and Permanence. Providing a 1.2 m (4-ft) thick engineered cap above contaminated areas and restricting activities conducted at TSF-07 is expected to reduce risks associated with potential direct exposure to radionuclides by limiting direct contact with contaminated soils. Continued environmental monitoring, annual inspections and cover maintenance activities (if required) would continue to monitor the long-term effectiveness and permanence of this alternative. In addition, five-year site reviews would be conducted for a period of 100 years. Therefore, this alternative would likely provide for long-term and permanent reduction in risks associated with direct exposure to radionuclides in soil at TSF-07.

12.2.3.4 Reduction of Toxicity, Mobility, or Volume Through Treatment. This alternative does not involve treatment of contaminated soils. There is no reduction of toxicity or volume with this alternative. Mobility of the contaminants would be reduced with the proposed cover.

12.2.3.5 Short-Term Effectiveness. Exposure to radionuclides in soil during installation of the engineered barrier would be minimized by the use of appropriate personal protective equipment, engineering controls, and adherence to INEEL health and safety protocols. During the placement of backfill materials and the construction of the lowermost layers of the cap earth moving equipment modified with positive-pressure ventilation system cabs and HEPA filters for use in radioactively-contaminated areas may be utilized. Equipment modified for use in radioactively-contaminated environments is available at the INEEL from previous remedial actions. If not available onsite, equipment may be supplied by a subcontractor or may be purchased from vendors. However, modification of subcontractor or purchased equipment may be necessary for use in a radioactively-contaminated environment. Emplacement of clean fill material and the lowermost layer(s) of the cover would add sufficient shielding throughout the remainder of construction activities.

Nonexposure risks to workers are also a consideration during consolidation of surface soils (if necessary) and construction of the barriers. These risks result primarily from physical construction hazards, such as vehicle accidents or personal injuries. These hazards can be minimized by implementation of appropriate health and safety measures for earth-moving construction activities. Based on DOE Order 5480.11, construction activities would be performed in accordance with the ALARA approach to radiation protection. RAOs would be achieved by this containment alternative once construction of the barrier is complete. Per DOE Order 5820.2A, requirements during implementation of this alternative, exposures to equipment operators must be maintained below 25 mrem/yr.

Environmental impacts resulting from construction activities would likely be minimal. The remoteness of the site would prevent any impact to the surrounding communities during construction activities. Installation of surface water diversion controls may result in alteration of the nearby terrain.

However, the overall impact of these activities is not considered irreparable and would be minimal in the long term. No environmentally sensitive areas such as archaeological or historical sites, wetlands, or critical habitat exist in the vicinity of TSF-07.

12.2.3.6 Implementability. This alternative is technically feasible at TSF-07. The technologies associated with implementation of this alternative are readily available through previous applications at INEEL. There are no site-specific conditions that exist at TSF-07 that would inhibit installation of the cap, perimeter security fence installation, or annual inspection and environmental monitoring activities. This barrier design has been selected, designed, and implemented for the INEEL SL-1 closure cover. Therefore, the technology, services, and specialists required to implement this barrier are readily available. The barrier design would be easily constructed. No specialized equipment or personnel would be necessary, and competitive bids could be easily obtained since a large number of construction firms are capable of performing the required work. Materials required for construction are anticipated to be available onsite at the INEEL. Materials located on the INEEL site would be used to construct the engineered barrier.

This alternative is administratively feasible. Long-term monitoring activities, maintenance of the cap (as necessary), and conducting five-year site reviews for a period of 100 years would require long-term coordination. However, this is not thought to present significant administrative difficulties.

12.2.3.7 Cost. The cost estimate developed for this alternative is based on constructing the engineered barrier, installing a perimeter security fence, performing environmental monitoring and annual inspection and maintenance activities (as necessary), and, for costing purposes, conducting five-year site reviews for a period of 100 years. Post-closure costs were estimated for a 100-year period of maintenance and monitoring. The estimated present worth value for this alternative at TSF-07 is shown in Table 12-4. The alternative cost estimate is for comparison purposes only and not intended for budgetary, planning, or funding purposes.

12.2.4 Alternative 3a: Excavation and On-Site Disposal

Implementation of this alternative would involve excavation of soils present above PRGs at TSF-06 (Area B) and TSF-07, and transportation to the proposed ER INEEL soil repository or RWMC for disposal. Conventional excavation and transportation equipment and procedures would be used under this alternative. Supplied air and shielding in the form of leaded windows and lead lining on exterior facing surfaces of the equipment would be used as needed. Excavation equipment modified with positive-pressure ventilation system cabs and HEPA filters for use in radioactively-contaminated areas is available at the INEEL from previous remedial actions. If not available onsite, excavation equipment may be supplied by a subcontractor or may be purchased from vendors. However, modification of subcontractor or purchased equipment may be necessary for use in a radioactively-contaminated environment.

During excavation activities, all uncontaminated soils (i.e., soils below the PRGs) would be stockpiled on site and replaced into excavated areas following removal of radionuclide-contaminated soils. Verification sampling would be used to ensure that all contamination present at concentrations exceeding PRGs was removed. The excavated areas would be backfilled with clean soil and revegetated to natural conditions following completion of excavation. Institutional controls would not be required after site excavation and disposal, since all contamination would be removed and all exposure pathways would be eliminated. Implementation of Alternative 3a would involve excavation of the following areas within each subsite:

Table 12-4. Alternative 2b: NPV for TSF-07.

Site	NPV ($)
TSF-07	4,528,918

- TSF-06 (Area B)—An approximate 165 by 30 m (550 by 100 ft) are including soils underneath and adjacent to Snake Avenue to a depth of 0.8 m (2.5 ft).

- TSF-07—An approximate 192 by 30 m (630 by 10 ft) and 131 by 24 m (430 by 80 ft) area of contaminated soil located in the main pond to a depth of 3 m (10 ft) below the pond bottom. A portion of the berm surrounding the pond would also require removal during excavation activities. The berm would be replaced upon completion of remedial activities.

12.2.4.1 Overall Protection of Human Health and the Environment. This alternative is anticipated to provide highly effective, long-term protection of human health and the environment. The removal of radionuclide-contaminated soil from TSF-06 (Area B) and TSF-07 would eliminate potential long-term human health and environmental concerns associated with direct exposure or contaminant migration from uncontrolled radioactive waste disposal sites. Therefore, this alternative meets specified RAOs. The on-site disposal facility would provide consolidation of the contaminated soils within a controlled disposal area where waste management controls are in place and would be maintained for the period of institutional controls.

12.2.4.2 Compliance with ARARs and TBCs. Table 12-1 presents the evaluation of the excavation with on-site disposal alternative for compliance with identified ARARs and TBCs. Compliance with the emissions control ARARs is ensured by performing excavation using water sprays and other techniques for dust suppression, as needed. Engineering controls for surface water runoff would insure compliance with 40 CFR 122.26 which regulates stormwater and associated discharges. The excavation and disposal alternative would meet TBCs including DOE Orders. DOE Orders would be met by implementing and enforcing applicable provisions of the Orders. Therefore, this alternative is capable of complying with all potential ARARs and TBCs identified.

12.2.4.3 Long-Term Effectiveness and Permanence. This alternative provides for a long-term and permanent reduction in human health risks because radionuclide-contaminated soils are completely removed at TSF-06 (Area B) and TSF-07 and consolidated in one location. The long-term risk to human health and the environment is basically transferred from the OU 1-10 sites to the centrally-managed on-site disposal facility. However, management practices at the proposed ER INEEL soil repository would be implemented to ensure minimal risks to human health and the environment.

12.2.4.4 Reduction of Toxicity, Mobility, or Volume Through Treatment. No treatment is specified under this alternative. Contaminants would be physically removed and contained in a centrally-managed on-site disposal location. Contaminant mobility, toxicity and volume would be eliminated at the individual OU 1-10 sites, although toxicity and volume would not be affected at the disposal location as part of this alternative. Contaminant mobility would be minimized at the disposal location through effective waste management practices.

12.2.4.5 Short-Term Effectiveness. The exposure risk to workers during excavation and removal of contaminated soil and debris at TSF-06 (Area B) and TSF-07 could be significant, however radiation monitoring and control measures have been demonstrated to effectively mitigate risks in previous INEEL removal actions. Short-term effectiveness is therefore assessed as moderate. Equipment operator exposures would be minimized to the extent possible using established procedures. Supplied air and shielding in the form of leaded windows and lead lining on exterior facing surfaces of the equipment would be used as needed. Excavation equipment modified with positive-pressure ventilation system cabs and HEPA filters for use in radioactively-contaminated areas is available at the INEEL from previous remedial actions. If not available onsite, excavation equipment may be supplied by a subcontractor or may be purchased from vendors. However, modification of subcontractor or purchased equipment may be necessary for use in a radioactively-contaminated environment. The activities associated with removing these soils would require exposure to radioactive materials. The operator risk would be directly related to the time required to perform the excavation. Exposure and risk per operator could be decreased by increasing the number of equipment operators, and decreasing the time spent on site by any one person.

Nonexposure risks to workers are also a consideration during excavation. These risks result primarily from physical construction hazards, such as vehicle accidents or personnel injuries. However, implementation of appropriate health and safety measures for the excavation activities can minimize these risks.

Environmental impacts resulting from this alternative are dependent on the remedial design and required access areas. The surrounding landscape would likely be disturbed because of the equipment and vehicles moving in and around the site. However, the impact of these activities would be temporary, and the entire site would be restored to match the surrounding landscape at the completion of the project. No environmentally sensitive archaeological or historical sites, wetlands, or critical habitat exist at the OU 1-10 sites.

RAOs would be achieved by this alternative once excavation and disposal at the on-site location is complete. To satisfy RAOs during implementation of this alternative, exposures to equipment operators must be reduced below 25 mrem/yr.

12.2.4.6 Implementability. This alternative is technically feasible at TSF-06 (Area B) and TSF-07. The technologies associated with the implementation of this alternative are readily available at the INEEL or surrounding communities. Implementation of this alternative would be moderately difficult because of the complexity of the retrieval system with respect to safety considerations and administrative constraints for on-site containment facility requirements. Significant effort would be required to perform environmental assessments, safety analyses, permit preparations, and equipment modifications (for operator safety), as well as system testing and demonstration. Although the equipment and technology are available to perform the activities specified in this alternative, increased risks to workers during excavation result in lower implementability, relative to other alternatives.

12.2.4.7 Cost. The costs for this alternative include conventional excavation and transportation of soils to an on-site disposal facility for disposal, backfilling of excavated areas, and grading and revegetating the sites to natural conditions. The cost analysis for this alternative assumes that no post-closure monitoring or care is required. The estimated NPV of Alternative 3a for each subsite is shown in Table 12-5. The alternative cost estimates are for comparison purposes only and not intended for budgetary, planning, or funding purposes.

Table 12-5. Alternative 3a: NPV for TSF-06 (Area B) and TSF-07.

Site	NPV ($)
TSF-06 (Area B)	2,474,519
TSF-07	20,939,553

12.2.5 Alternative 3b: Excavation and Off-Site Disposal

Implementation of this alternative would involve excavation of soils present above PRGs at TSF-06 (Area B) and TSF-07 and transportation off-site to a permitted landfill for disposal. The most likely off-site disposal location would be Envirocare which is located approximately 480 km (300 mi) south of INEEL. Envirocare is a permitted low-level waste disposal facility in northwestern Utah. Compliance with appropriate waste characterization, transportation, and possible treatment requirements imposed by the off-site disposal facility would be required under this alternative.

Conventional excavation and transportation equipment and procedures would be used under this alternative. Supplied air and shielding in the form of leaded windows and lead lining on exterior facing surfaces of the equipment would be used as needed. Excavation equipment modified with positive-pressure ventilation system cabs and HEPA filters for use in radioactively-contaminated areas is available at the INEEL from previous remedial actions. If not available onsite, excavation equipment may be supplied by a subcontractor or may be purchased from vendors. However, modification of subcontractor or purchased equipment may be necessary for use in a radioactively-contaminated environment

During excavation activities, all uncontaminated soils would be stockpiled on site and replaced into excavated areas following removal of radionuclide-contaminated soils. Verification sampling would be used to ensure that all contamination present at concentrations exceeding PRGs was removed. Clean soil would be used to backfill excavated areas to natural grade. Areas impacted by excavation and stockpiling activities would be revegetated to natural conditions. Institutional controls would not be required after site excavation and disposal, since all contamination would be removed and all exposure pathways would be eliminated. Implementation of this alternative would involve excavation of the following areas within each subsite:

- TSF-06 (Area B)—An approximate 165 by 30 m (550 by 100 ft) area including soils underneath and adjacent to Snake Avenue to a depth of 0.8 m (2.5 ft).

- TSF-07—An approximate 192 by 30 m (630 by 100 ft) and 131 by 24 m (430 by 80 ft) area of contaminated soil located in the main pond to a depth of 3 m (10 ft) below the pond bottom. A portion of the berm surrounding the pond would also require removal during excavation activities. The berm would be replaced upon completion of remedial activities.

12.2.5.1 Overall Protection of Human Health and the Environment. This alternative is anticipated to provide highly effective, long-term protection of human health and the environment. The removal of radionuclide-contaminated soil from TSF-06 (Area B) and TSF-07 would eliminate potential long-term human health and environmental concerns associated with direct exposure or contaminant migration from uncontrolled radioactive waste disposal sites. Therefore, this alternative meets specified RAOs. The off-site disposal facility provides consolidation of the contaminated soils within a controlled disposal area where waste management controls are in place and would be maintained for the period of institutional controls.

12.2.5.2 Compliance with ARARs and TBCs. Table 12-1 presents the evaluation of this alternative for compliance with identified ARARs and TBCs. Compliance with the emissions control ARARs is ensured by performing excavation using water sprays and other techniques for dust suppression, as needed. 40 CFR 122.26, regulating stormwater and associated discharges, would be met by engineering controls on surface water runoff. Alternative 3b would meet TBCs including DOE Orders. DOE Orders would be met by implementing and enforcing applicable provisions of the Orders. Therefore, this alternative is capable of complying with all potential ARARs and TBCs identified.

12.2.5.3 Long-Term Effectiveness and Permanence. This alternative provides for a long-term and permanent reduction in human health risks because radionuclide-contaminated soils are completely removed at TSF-06 (Area B) and TSF-07 and consolidated in one location. The long-term risk to human health and the environment is basically transferred from the OU 1-10 subsites to the managed off-site disposal facility. However, existing management practices at the off-site repository are implemented to ensure minimal risks to human health and the environment.

12.2.5.4 Reduction of Toxicity, Mobility, or Volume Through Treatment. No treatment is directly specified under this alternative. Contaminants would be physically contained in the centrally-managed off-site disposal location. Contaminant mobility, toxicity and volume would be eliminated at the individual OU 1-10 subsites, although toxicity and volume would not be affected at the off-site disposal location as part of this alternative. Contaminant mobility would be minimized at the disposal location through effective waste management practices.

12.2.5.5 Short-Term Effectiveness. The exposure risk to workers during excavation and removal of contaminated soil and debris at TSF-06 (Area B) and TSF-07 could be significant, however radiation monitoring and control measures have been demonstrated to effectively mitigate risks in previous INEEL removal actions. Short-term effectiveness is therefore assessed as moderate. Equipment operator exposures would be minimized to the extent possible using established procedures. Supplied air and shielding in the form of leaded windows and lead lining on exterior facing surfaces of the equipment would be used as needed. Excavation equipment modified with positive-pressure ventilation system cabs and HEPA filters for use in radioactively-contaminated areas is available at the INEEL from previous remedial actions. If not available onsite, excavation equipment may be supplied by a subcontractor or may be purchased from vendors. However, modification of subcontractor or purchased equipment may be necessary for use in a radioactively-contaminated environment. The activities associated with removing these soils would require exposure to radioactive materials. The operator risk would be directly related to the time required to perform the excavation. Exposure and risk per operator could be decreased by increasing the number of equipment operators, and decreasing the time spent on site by any one person.

Nonexposure risks to workers are also a consideration during excavation. These risks result primarily from physical construction hazards, such as vehicle accidents or personnel injuries. However, implementation of appropriate health and safety measures for the excavation activities can minimize these risks.

Environmental impacts resulting from this alternative are dependent on the remedial design and required access areas. The surrounding landscape would likely be disturbed because of the equipment and vehicles moving in and around the site. However, the impact of these activities would be temporary, and the entire site would be restored to match the surrounding landscape at the completion of the project. No environmentally sensitive archaeological or historical sites, wetlands, or critical habitat exist at the OU 1-10 sites.

RAOs would be achieved by this alternative once excavation and disposal at the on-site location is complete. Per DOE Order 5820.2A requirements during implementation of this alternative, exposures to equipment operators must be reduced below 25 mrem/yr.

12.2.5.6 *Implementability.* Alternative 3b is technically feasible at TSF-06 (Area B) and TSF-07. The technologies associated with the implementation of this alternative are readily available at the INEEL or surrounding communities. Implementation of this alternative would be moderately difficult because of the complexity of the retrieval system with respect to safety considerations and off-site containment requirements. Significant effort would be required to perform environmental assessments, safety analyses, permit preparations, and equipment modifications (for operator safety), as well as system testing and demonstration. Although the equipment and technology are available to perform the activities specified in this alternative, increased risks to workers during excavation result in a moderate implementability.

Off-site transportation of contaminated materials presents potential administrative constraints due to potential exposures to human receptors between INEEL and the disposal facility. Coordination would be required between INEEL and disposal facility personnel to ensure disposal criteria are met before contaminated materials are excavated for off-site transport.

12.2.5.7 *Cost.* The costs of this alternative include conventional excavation and transportation of soils to an off-site disposal facility for disposal, backfilling of excavated areas, and grading and revegetating the sites to natural conditions. The cost analysis for this alternative assumes that no post-closure monitoring or care is required. The estimated NPV of Alternative 3b for TSF-06 (Area B) TSF-07 is shown in Table 12-6 The alternative cost estimates are for comparison purposes only and not intended for budgetary, planning, or funding purposes.

12.2.6 Summary of Individual Analyses for Radionuclide-Contaminated Soils

Table 12-7 summarizes the detailed analysis for OU-1-10 radionuclide-contaminated sites. The total NPV estimated for the alternatives was not included on Table 12-7 due to variation in subsites addressed by each alternative.

12.3 Comparative Analysis of Alternatives for Radionuclide-Contaminated Soils

The comparative analysis provides a measure of the relative performance of alternatives against each evaluation criterion. The purpose of this comparison is to identify the relative advantages and disadvantages associated with each alternative. The comparative analysis does not identify a preferred alternative, but provides sufficient information to enable this selection by DOE-ID, EPA, and IDHW decision makers. The following sections present the alternative comparisons relative to each evaluation criterion, for each grouping of sites. Table 12-8 summarizes how each alternative satisfies the RAOs identified in Section 9.1. Table 12-9 summarizes the relative ranking of alternatives. Each of the evaluation criteria are discussed in the following subsections.

12.3.1 Overall Protection of Human Health and the Environment

The primary measure of this criterion is the ability of an alternative to achieve RAOs for the OU 1-10 radionuclide-contaminated sites. Table 12-8 provides a summary of the comparison of

Table 12-6 Alternative 3b: NPV for TSF-06 (Area B) and TSF-07.

Site	NPV ($)
TSF-06 (Area B)	5,127,746
TSF-07	54,012,037

Table 12-7. Detailed analysis summary for OU 1-10 radionuclide-contaminated sites.

Criteria	Alternative 1 No Action/Limited Action	Alternative 2a Native Soil Cover	Alternative 2b Engineered Barrier	Alternative 3a Excavation and On-site Disposal	Alternative 3b Excavation and Off-site Disposal
Overall protection of human health and the environment					
Human health protection	Access restrictions and monitoring reduce direct exposure to contaminated soil and debris.	Cap would prevent direct exposure to contaminated soil and debris. Minimal exposure risks during cap construction.	Cap would prevent direct exposure to contaminated soil and debris. Minimal exposure risks during cap construction.	Eliminates potential exposure from contaminated soil at site. Protectiveness is based on completely removing contamination from site. Short-term risk is moderate due to direct exposure during excavation.	Eliminates potential exposure from contaminated soil at site. Protectiveness is based on completely removing contamination from site. Short-term risk is moderate due to direct exposure during excavation.
Environmental protection	Surface water erosion controlled through surface water diversions.	Provides protection from direct exposure to contaminated soil and debris for the lifetime of the cap. Minimal environmental impacts during construction.	Provides protection from direct exposure to contaminated soil and debris for the lifetime of the cap. Minimal environmental impacts during construction.	Eliminates contamination from site.	Eliminates contamination from site.
Compliance with ARARs					
Action-specific					
Idaho Fugitive Dust Emissions—IDAPA 16.01.01650 et seq.	Would meet ARAR based on modeled BRA results.	Would meet ARAR by eliminating potential for windblown soil contamination	Would meet ARAR by eliminating potential for windblown soil contamination	Would meet ARAR by eliminating potential for windblown soil contamination with use of water sprays during excavation.	Would meet ARAR by eliminating potential for windblown soil contamination with use of water sprays during excavation.
Toxic Substances—IDAPA 16.01.01161	Would meet ARAR based on modeled BRA results.	Would meet ARAR by eliminating potential for windblown soil contamination	Would meet ARAR by eliminating potential for windblown soil contamination	Would meet ARAR by eliminating potential for windblown soil contamination with use of water sprays during excavation.	Would meet ARAR by eliminating potential for windblown soil contamination with use of water sprays during excavation.

Table 12-7. (continued).

Criteria	Alternative 1 No Action/Limited Action	Alternative 2a Native Soil Cover	Alternative 2b Engineered Barrier	Alternative 3a Excavation and On-site Disposal	Alternative 3b Excavation and Off-site Disposal
Idaho Hazardous Waste Management Act—IDAPA 16.01.05.004 16.01.05.006 16.01.05.005 16.01.05.008 16.01.05.011	Not ARAR	Not ARAR	Not ARAR	Would meet ARAR through proper waste characterization, transportation, and disposal methods.	Would meet ARAR through proper waste characterization, transportation, and disposal methods.
Chemical-specific					
NESHAPS - Radionuclides other than Radon-222 and Radon-220 at DOE facilities – Emission Standard 40 CFR 61.92	Not ARAR	Not ARAR	Not ARAR	Not ARAR	Not ARAR
Rules for the Control of Air Toxics in Idaho (Air Toxics Rules)—IDAPA 16.01.01585 and 16.01.01586	Not ARAR, no air toxics at site.	Not ARAR, no air toxics at site.	Not ARAR, no air toxics at site.	Not ARAR, no air toxics at site.	Not ARAR, no air toxics at site.
Safe Drinking Water Act—40 CFR 141	Not ARAR, no threat to groundwater or surface water.	Not ARAR, no threat to groundwater or surface water.	Not ARAR, no threat to groundwater or surface water.	Not ARAR, no threat to groundwater or surface water.	Not ARAR, no threat to groundwater or surface water.
Location-specific					
National Historic Preservation Act—16 USC 470 et seq.	Not ARAR, all activities would occur outside designated areas.	Not ARAR, all activities would occur outside designated areas.	Not ARAR, all activities would occur outside designated areas.	Not ARAR, all activities would occur outside designated areas.	Not ARAR, all activities would occur outside designated areas.

Table 12-7. (continued).

Criteria	Alternative 1 No Action/Limited Action	Alternative 2a Native Soil Cover	Alternative 2b Engineered Barrier	Alternative 3a Excavation and On-site Disposal	Alternative 3b Excavation and Off-site Disposal
Storm Water Discharges—40 CFR 122.26	Would meet ARAR through use of engineering controls.	Would meet ARAR through use of engineering controls.	Would meet ARAR through use of engineering controls.	Would meet ARAR through use of engineering controls.	Would meet ARAR through use of engineering controls.
TBCs					
Environmental Protection, Safety and Health Protection Standards–DOE Order 5480.4	Would not meet TBC because no controls would be implemented post-institutional control period	Would meet TBC through use of engineering and institutional controls and best management practices.	Would meet TBC through use of engineering and institutional controls and best management practices.	Would meet TBC through use of engineering and institutional controls and best management practices..	Would meet TBC through use of engineering and institutional controls and best management practices.
Radioactive Waste Management–DOE Order 5820.2A	Would not meet TBC because no controls would be implemented post-institutional control period	Would meet TBC through use of engineering and institutional controls and best management practices.	Would meet TBC through use of engineering and institutional controls and best management practices.	Would meet TBC through use of engineering and institutional controls and best management practices.	Would meet TBC through use of engineering and institutional controls and best management practices.
Radiation Protection of the Public and Environment–DOE Order 5400.5	Would not meet TBC because no controls would be implemented post-institutional control period	Would meet TBC through use of engineering and institutional controls and best management practices.	Would meet TBC through use of engineering and institutional controls and best management practices.	Would meet TBC through use of engineering and institutional controls and best management practices.	Would meet TBC through use of engineering and institutional controls and best management practices.
Long-term effectiveness and permanence					
Magnitude of residual risk	Risk is reduced as long as access controls are maintained. Inherent hazards of soil and debris would remain.	Source-to-receptor pathways eliminated while cap remains in place (at least 500–1,000 years). Inherent hazards of soil and debris would remain.	Source-to-receptor pathways eliminated while cap remains in place (at least 500–1,000 years). Inherent hazards of soil and debris would remain.	No residual risk would remain at OU 1-10.	No residual risk would remain at OU 1-10.

Table 12-7. (continued).

Criteria	Alternative 1 No Action/Limited Action	Alternative 2a Native Soil Cover	Alternative 2b Engineered Barrier	Alternative 3a Excavation and On-site Disposal	Alternative 3b Excavation and Off-site Disposal
Adequacy and reliability of controls	Limited access to contaminated soil and environmental monitoring effective only during institutional period of control (100 years).	Limited access to contaminated soil and environmental monitoring effective only during institutional period of control (100 years). Barrier control over contaminated soil for at least 500–1,000 years.	Limited access to contaminated soil and environmental monitoring effective only during institutional period of control (100 years). Barrier control over contaminated soil for at least 500–1,000 years.	Proposed ER INEEL Soil Repository is assumed to provide adequate and reliable control over disposed soil and debris for the period of institutional controls.	Envirocare is assumed to provide adequate and reliable control over disposed soil and debris.
Reduction of toxicity, mobility, or volume through treatment					
Treatment process used	Not applicable.	No treatment, however, would reduce the mobility of contaminants.	No treatment, however, would reduce the mobility of contaminants.	No treatment, however, would completely remove contaminants at the subsites.	No treatment, however, would completely remove contaminants at the subsites.
Amount destroyed or treated	Not applicable.	Not applicable.	Not applicable	Not applicable.	Not applicable
Reduction of toxicity, mobility, or volume	Not applicable.	Mobility reduced	Mobility reduced	Mobility Reduced. Removal of contamination at subsite eliminates monitoring requirements.	Mobility Reduced. Removal of contamination at subsite eliminates monitoring requirements.
Irreversible treatment	Not applicable.	Not applicable.	Not applicable	Not applicable.	Not applicable
Type and quantity of residuals remaining after treatment	Not applicable.	Not applicable.	Not applicable	Not applicable.	Not applicable
Statutory preference for treatment	Not applicable.	Not applicable.	Not applicable	Not applicable.	Not applicable
Short-term effectiveness					
Community protection	No increase in potential risks to the public.	No increase in potential risks to the public.	No increase in potential risks to the public.	No increase in potential risks to the public.	No increase in potential risks to the public.

Table 12-7. (continued).

Criteria	Alternative 1 No Action/Limited Action	Alternative 2a Native Soil Cover	Alternative 2b Engineered Barrier	Alternative 3a Excavation and On-site Disposal	Alternative 3b Excavation and Off-site Disposal
Worker protection	Not applicable.	Worker risk during soil cover installation is minor due to shielding afforded by existing clean soil surface layers and installation of lowermost layer(s).	Worker risk during barrier installation is minor due to shielding afforded by existing clean soil surface layers and installation of lowermost layer(s).	Worker risk from exposure to contaminated soil and debris will require engineering controls, use of excavation equipment modified for use in radioactively-contaminated environments.	Worker risk from exposure to contaminated soil and debris will require engineering controls, use of excavation equipment modified for use in radioactively-contaminated environments.
Environmental impacts	No change from existing conditions.	Limited to disturbances from vehicle and material transport activities associated with soil cover construction. Limited potential for airborne contamination in the form of fugitive dust, due to use of water sprays.	Limited to disturbances from vehicle and material transport activities associated with barrier construction. Limited potential for airborne contamination in the form of fugitive dust, due to use of water sprays.	Limited to disturbances from vehicle and material transport activities associated with excavation. Limited potential for airborne contamination in the form of fugitive dust, due to use of water sprays.	Limited to disturbances from vehicle and material transport activities associated with excavation. Limited potential for airborne contamination in the form of fugitive dust, due to use of water sprays.
Time until action is complete	30 years	FY 2001[a]	FY 2001[a]	FY 2001[a]	FY 2001[a]
Implementability					
Ability to construct and operate	Long term management and monitoring of sites required. Access restrictions may be administratively difficult to obtain.	Involves available construction technology. Equipment may require modifications for health and safety. Long term management and monitoring of sites required.	Involves available construction technology. Equipment may require modifications for health and safety. Long term management and monitoring of sites required.	Involves available construction technology. Equipment may require modifications for health and safety.	Involves available construction technology. Equipment may require modifications for health and safety.

Table 12-7. (continued).

Criteria	Alternative 1 No Action/Limited Action	Alternative 2a Native Soil Cover	Alternative 2b Engineered Barrier	Alternative 3a Excavation and On-site Disposal	Alternative 3b Excavation and Off-site Disposal
Ease of implementing additional action if necessary	May require repeat of feasibility study/record of decision process.	Additional remedial actions would be difficult, as the soil cover is intended to prevent access to contamination. Soil cover would require removal.	Additional remedial actions would be difficult, as the barrier is intended to prevent access to contamination. Barrier would require removal.	Additional remedial action would not be necessary, as all contaminated soil and debris are removed.	Additional remedial action would not be necessary, as all contaminated soil and debris are removed.
Ability to monitor effectiveness	Conditions at site are easily monitored.	Soil cover performance can be monitored through radiation surveys, can be visually assessed on the basis of physical integrity.	Barrier performance can be monitored through radiation surveys, can be visually assessed on the basis of physical integrity.	The effectiveness in removing all contaminated materials associated with site is easily monitored.	The effectiveness in removing all contaminated materials associated with site is easily monitored.
Ability to obtain approvals and coordinate with regulatory agencies	No approvals required.	No difficulties identified.	No difficulties identified.	Moderately difficult due to potential requirements for environmental assessments and safety analyses.	Moderately difficult due to potential requirements for environmental assessments and safety analyses.
Availability of services and capacity	None required.	Soil cover design and services reside within the DOE and are considered readily available to INEEL.	Barrier design and services reside within the DOE and are considered readily available to INEEL.	Services available either onsite or through subcontractor.	Services available either onsite or through subcontractor.
Availability of equipment, specialists, and materials	Readily available for access restrictions and environmental monitoring.	Equipment and materials are readily available at the INEEL or within the surrounding community.	Equipment and materials are readily available at the INEEL or within the surrounding community.	Equipment and materials are either available onsite through subcontractors or will be purchased. Trained specialists are available within the communities surrounding the INEEL.	Equipment and materials are either available onsite through subcontractors or will be purchased. Trained specialists are available within the communities surrounding the INEEL.
Availability of technology	None required	Readily available at the INEEL.	Readily available at the INEEL.	Readily available at the INEEL.	Readily available at the INEEL.
Net Present Value					
	See detailed analysis	See detailed analysis	See detailed analysis	See detailed analysis	See detailed analysis

a. Baseline estimate for completion of remedial action. Does not include any required monitoring.

Table 12-8. Comparison of alternatives with RAOs.

Criteria	Alternative 1 No Action/Limited Action	Alternative 2a Native Soil Cover	Alternative 2b Engineered Barrier	Alternative 3a Excavation and On-site Disposal	Alternative 3b Excavation and Off-site Disposal
RAOs for contaminated soil					
Prevention of direct exposure	Inhibits direct exposure to contaminated soils by imposing access restrictions.	Inhibits direct exposure to contaminated soils by providing a 3 m (10 ft) thick cover over contaminated areas.	Inhibits direct exposure to contaminated soils by providing an approximately 1.2 m (4 ft) thick engineered barrier over contaminated areas.	Eliminates potential exposure by removing contamination.	Eliminates potential exposure by removing contamination.

Table 12-9. Summary of comparative analysis of alternatives.

Criterion	Alternative 1: No Action/Limited Action	Alternative 2a: Native Soil Cover (for TSF-06 and TSF-07 only)	Alternative 2b: Engineered Barrier (for TSF-06 and TSF-07 only)	Alternative 3a: Excavation and On-site Disposal	Alternative 3b: Excavation and Off-site Disposal
Overall protection of human health and the environment	0	+	+	0	0
Compliance with ARARs	–	+	+	+	+
Long-term effectiveness and permanence	–	0	0	+	+
Reduction of toxicity, mobility, or volume through treatment	–	0	0	0	0
Short-term effectiveness	+	0	0	–	–
Implementability	+	0	0	–	–
Cost	+	0	0	0	–

Notes:

\+ Favorable relative ranking.

0 Neutral relative ranking.

– Unfavorable relative ranking.

alternatives with RAOs. Alternative 1 (No Action/Limited Action) would prevent external exposure to contaminated surface soil below 1E–04. Alternative 3a and 3b (Excavation and On-site or Off-site Disposal) provides effective long-term protection of human health and the environment, but at the expense of short-term protection for site workers. Both containment alternatives (2a and 2b) provide effective short-term and long-term protection of human health and the environment for TSF-07 with relatively minor differences. Design lives for the two covers are roughly equivalent. The engineered cover (2b) would afford more resistance to erosion and to human and biotic intrusion, than the native soil cover (2a).

12.3.2 Compliance with ARARs

Each of the alternatives evaluated for radionuclide-contaminated soils would likely meet the potential ARARs or TBCs triggered by each alternative with the exception of No Action/Limited Action. TBCs would not be met because no controls would be implemented after the institutional control period. The remaining alternative are equally ranked with respect to compliance with ARARs.

12.3.3 Long-Term Effectiveness and Permanence

Alternatives 3a and 3b (Excavation and On-site or Off-site Disposal) provides the highest degree of long-term effectiveness and permanence, because contaminated soil and debris would no longer exist at the site. Alternative 1 (No Action/Limited Action) and Alternatives 2a (Native Soil Cover) and 2b (Engineered Barrier) are lower ranked than Alternatives 3a and 3b because of the long-term maintenance requirements in addition to the management and monitoring activities associated with these alternatives. Alternative 2b would likely provide more resistance to erosion, and to human and biotic intrusion, than Alternative 2a.

12.3.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

The alternatives developed for the radionuclide contaminated sites do not include treatment. However, Alternative 1 (No Action/Limited Action) alternatives would have the least effect on contaminant mobility compared to the other alternatives. Reduction in contaminant mobility would be approximately the same under Alternatives 2a, 2b, 3a, and 3b. Toxicity and volume would not be affected with any of the alternatives.

12.3.5 Short-Term Effectiveness

Based on the limited amount of activities performed at each subsite, Alternative 1 (No Action/Limited Action) is considered the highest ranked with respect to short-term effectiveness. Alternatives 2a and 2b are the next highest ranked. The site is not located near inhabited areas and no public roads are in the vicinity. No significant impacts to worker and surrounding communities would be anticipated. No additional environmental impacts would result from these alternatives. Alternatives 2a and 2b are considered equally effective for short-term protection. Exposure risks to workers during cover construction would be minimal, and are independent of the cover design. Personal protective equipment and adherence to health and safety protocols would minimize exposures during consolidation activities. Existing clean soil and initial foundation layers would likely provide sufficient shielding to reduce direct exposure to workers to acceptable levels. Environmental impacts are considered minimal and result primarily from cap construction activities. Fill material placed as a cap foundation would prevent contaminant migration to the surrounding environment in addition to providing shielding for workers. RAOs can be achieved with the containment alternatives after a cover is in place. The cover construction schedule is generally equivalent between the alternatives.

Alternatives 3a and 3b (Excavation and On-site or Off-site Disposal) are considered the least effective for short-term protection. The risk to workers resulting from direct exposure to the contaminated soil and debris is considered significant. Environmental impacts would be minimized by maintaining dust suppression controls during excavation and transportation. Surrounding communities would be more affected by alternative 3b than 3a.

12.3.6 Implementability

Each of the alternatives retained for detailed analysis is technically implementable. Alternatives 3a and 3b are more difficult to implement because of the complexity of the excavation activities, however the individual technologies specified for this alternative are available and have been demonstrated. Alternatives 3a and 3b would also require significant resources to perform environmental assessments, safety analyses, and permit applications. Alternative 3b may be more difficult to implement than Alternative 3a due to the difficulties associated with transportation of contaminated soils off-site.

Alternatives 2a and 2b (containment alternatives) are relatively equally implementable for TSF-07. Due to the differences in the complexity of the cap designs associated with each containment alternative, Alternative 2a may be slightly easier to implement due to the more simplistic cap design relative to that specified in Alternative 2b. However, both designs are straightforward, and significant construction experience has been developed at INEEL. Alternatives 2a and 2b are not considered implementable for TSF-06 (Area B) due to the location of Snake Avenue.

Alternative 1 (No Action/Limited Action) is easily implemented and would result in minor changes to the existing conditions at the site and is therefore the most implementable alternative.

12.3.7 Cost

The relative ranking of the alternatives with respect to NPV is presented in Table 12-9. The level of detail used to develop the cost estimates presented is considered appropriate for comparing alternatives. Detailed cost summaries and assumptions for each estimate are provided in Appendix J. The uncertainty associated with each cost estimate increases with the complexity of the alternative. Consequently, the cost estimates developed for Alternative 3 (excavation) have the highest uncertainty. The results of the comparative analysis of cost estimated for each subsite include the following:

- TSF-06 (Area B)—Alternatives 1 and 3a were the lowest cost alternatives for this subsite. The costs associated with Alternative 3b were significantly higher than Alternatives 1 and 3a. Alternatives 2a and 2b are not applicable for this subsite.

- TSF-07—Alternative 1 was the lowest cost alternative followed by Alternatives 2a and 2b respectively. The costs associated with Alternatives 3a and 3b were significantly higher than the other alternatives, with Alternative 3b having the highest costs for this subsite.

12.3.8 Summary of Comparative Analysis of Alternatives

Table 12-9 provides a summary of the comparative analysis among the candidate alternatives. Relative rankings were assigned to each alternative based on the various evaluation criteria. A value of "+" indicates a favorable ranking relative to other alternatives for that criteria. A value of "0" indicates a neutral relative ranking and a value of "–" indicates an unfavorable ranking relative to other alternatives.

12.4 Individual Analysis of Alternatives For Nonradionuclide-Contaminated Soils

In accordance with CERCLA RI/FS guidance, remedial action alternatives retained for detailed analysis are individually assessed against the evaluation criteria stated in Section 12.1, not including state and community acceptance. The individual analysis of each alternative developed to address nonradionuclide-contaminated soils at Water Reactor Research Test Facility (WRRTF)-01, WRRTF-13, TSF-03, and TSF-08 is presented in the following subsections.

12.4.1 Alternative 1: No Action/Limited Action

The No Action/Limited Action alternative is presented to comply with requirements of the NCP [40 CFR 300.430 (e)(6)] and guidance for conducting FSs under CERCLA (EPA 1988). The No Action/Limited Action alternative provides a baseline with which other alternatives can be compared. Limited activities would be included as part of this alternative and consist of continuation of ongoing INEEL site wide environmental monitoring under the RESP and SESP, maintenance of existing institutional controls at WRRTF-01, WRRTF-13, TSF-03, and TSF-08, and potential expansion of environmental monitoring and institutional controls to accommodate site-specific concerns as required.

Monitoring activities may consist of the collection and analysis of groundwater, soil, biota, and other media from the site as applicable. Groundwater monitoring may include monitoring contaminant migration in groundwater beneath the site. Soil monitoring would include collecting samples over and around sites where contaminated soil and debris are left in place, to evaluate if contaminants have been mobilized to the surface.

Institutional controls would consist of restricting access to the subsites using controls such as fencing and legal restrictions. Surface water diversion controls would be implemented as appropriate to prevent storm-water from entering affected areas. In addition, five-year site reviews would be conducted to evaluate the effectiveness of the institutional controls and the need for further environmental monitoring, or additional control measures, as applicable. Five-year site reviews would be conducted for a duration of 100 years. The details associated with implementation of this alternative for WRRTF-01, WRRTF-13, TSF-03, and TSF-08 are discussed in the following paragraphs.

At WRRTF-01, environmental monitoring would be continued and expanded to include monitoring activities for lead. Current management practices such as restricting activities conducted at WRRTF-01 without clearance from the INEEL ER directorate would also be continued. A perimeter security fence with appropriate signage would be installed around the extent of WRRTF-01 Pit 1, Pit 2, and Pit 4, estimated to be approximately 122 × 50 m (400 × 164 ft). The extent of the perimeter security fence would not need to encompass Pit 3 because lead was not detected at levels above the PRG in samples taken from Pit 3.

At WRRTF, environmental monitoring would be continued and expanded to include monitoring activities for petroleum products. Current management proactive such as restricting activities conducted at WRRTF without clearance from the INEEL ER dictorate would also be continued. Appropriate signage would be installed at the area. A perimeter security fence would not be required as the subsite is within the WRRTF perimeter security fence and because it is beneath a parking lot.

At TSF-03, environmental monitoring would be continued and expanded to include monitoring activities for lead. Current management practices such as restricting activities conducted at TSF-03 without clearance from the INEEL ER directorate would also be continued. A perimeter security fence with appropriate signage would be installed around the entire extent of the burn pit at TSF-03 which is approximately 8 × 20 m (26 × 64 ft).

At TSF-08, environmental monitoring would be continued and expanded to include monitoring for mercury. Current management practices such as restricting activities conducted at TSF-08 without clearance from the INEEL ER directorate would also be continued. A perimeter security fence with appropriate signage would be installed around the portion of TSF-08 with soil concentrations above the mercury PRG, estimated to be approximately 12 × 3m (40 × 10 ft).

12.4.1.1 Overall Protection of Human Health and the Environment. Under the No Action/Limited Action alternative, human health and environmental risks and would be reduced by limiting potential exposure to lead in soils at WRRTF-01 and TSF-03, diesel at WRRTF-13 and mercury in soils at TSF-08. Therefore, continuation of environmental monitoring, installation of a perimeter security fence and imposing legal restrictions meets specified RAOs and provides for overall protection of human health and the environment at WRRTF-01, WRRTF-13, TSF-03, and TSF-08.

12.4.1.2 Compliance with ARARs and TBCs. Table 12-1 presents the evaluation of the No Action/Limited Action alternative for compliance with the ARARs and TBCs. While this alternative does not involve any construction or operational activities that would result in disturbances to the surfaces of the WRRTF-01, WRRTF-13, TSF-03, and TSF-08, IDAPA 16.01.01650 could nonetheless apply if the subsites were a source of fugitive dust and is therefore considered an ARAR. Based on modeled results in the BRA, this ARAR would be met. IDAPA 16.01.01161 would also be met by this alternative. Engineering controls for surface water runoff would ensure compliance with 40 CFR 122.26, which regulates stormwater and associated discharges. This alternative would meet DOE Order 5480.4 because health risks to current and potential future workers and residents would be minimized to within allowable ranges.

12.4.1.3 Long-Term Effectiveness and Permanence. This alternative provides for long-term and permanent control of human and environmental exposure to contaminated soils through continued environmental monitoring, and access restrictions imposed at WRRTF-01, WRRTF-13, TSF-03, and TSF-08. Because potential residential exposure to lead in soil at WRRTF-01, and TSF-03, diesel at WRRTF-13 and mercury in soil at TSF-08 is prevented, the long-term effectiveness and permanence of the limited action alternative is considered high.

12.4.1.4 Reduction of Toxicity, Mobility, or Volume Through Treatment. No treatment is associated with this alternative. Toxicity, mobility, and volume of contaminated soils would remain unchanged.

12.4.1.5 Short-Term Effectiveness. This alternative can be readily implemented without additional risks to the community, workers, or the environment. No specialized equipment, personnel, or services are required to implement the limited action alternative.

12.4.1.6 Implementability. This alternative is technically feasible and has a moderate administrative feasibility. There are no site-specific conditions that exist at WRRTF-01, WRRTF-13, TSF-03, and TSF-08 that would inhibit environmental monitoring or perimeter security fence installation activities. WRRTF-13 is beneath a parking lot which would not permit a security fence, but is inside the WRTF security fence. Long-term management and monitoring of WRRTF-01, WRRTF-13, TSF-03, and TSF-08 would be required. Although not anticipated, if opposition to access restrictions were met, gaining approval could be administratively difficult. Equipment and materials required for implementation of this alternative are readily available. Overall, implementability of the No Action/Limited Action is considered high.

12.4.1.7 Cost. The costs associated with the No Action/Limited Action alternative include installation of a perimeter security fence, imposing legal land-use restrictions, conducting periodic monitoring activities (specifically for lead at WRRTF-01 and TSF-03, diesel at WRRTF-13, and mercury at TSF-08), and conducting five-year site reviews for a period of 100 years. Post-closure costs were estimated for a 100-year monitoring period. The estimated NPV for each subsite is shown in Table 12-10. The alternative cost estimates are for comparison purposes only and not intended for budgetary, planning, or funding purposes.

12.4.2 Alternative 2: Native Soil Cover

The native soil cover for OU 1-10 nonradionuclide-contaminated sites is intended to provide 3 m (10 ft) of clean INEEL native soils and rip rap above areas with soil concentrations above PRGs. Implementing this alternative at WRRTF-01, TSF-03, and TSF-08 would consist of adding soil and rip rap layers above grade to bring the total thickness of clean soils above the contaminated soils to 3 m (10 ft). The native soil cover would be constructed with a top slope of 2% and integrated into the natural surrounding grade with a 4:1 slope constructed at the edge of the 3 m (10 ft) soil cover. The surface of the soil cover would be vegetated with a crested wheatgrass to limit infiltration and erosion. Site-specific considerations would be used to design the optimum configuration for application at WRRTF-01, TSF-03, and TSF-08 during the remedial design phase.

Conventional earthmoving equipment would be utilized for cap construction. Exposure to lead and mercury in soils would be minimized during construction activities through the use of personal protective equipment and engineering controls. Surface water controls would be implemented during construction.

Environmental monitoring (air, soil, and groundwater, as applicable), and cap integrity monitoring and maintenance (repairing any observable degradation including cracks, erosion, biotic intrusion, etc.) would be conducted on an annual basis as part of this alternative. Current management practices such as restricting activities conducted at the sites without clearance from INEEL ER Directorate would be continued. Fencing and legal land-use restrictions would also be implemented. Five-year site reviews would be conducted to evaluate the effectiveness of the native soil cover and the need for additional environmental monitoring or control requirements, as necessary. Five year site reviews would be conducted for a duration of 100 years. The details associated with implementation of this alternative for WRRTF-01, TSF-03, and TSF-08 are discussed in the following paragraphs.

At WRRTF-01, approximately 2.6 m (8.5 ft) of clean INEEL soils would be placed over the extent of WRRTF-01 Pit 1, Pit 2, and Pit 4, estimated to be an approximate 122 m × 50 m (400 × 164 ft) area. The extent of the native soil cover would not need to encompass Pit 3 because lead was not detected at

Table 12-10. Alternative 1: NPV for WRRTF-01, WRRTF-13, TSF-03, and TSF-08.

Site	NPV ($)
WRRTF-01	1,502,290
WRRTF-13	1,399,757
TSF-03	1,392,212
TSF-08	1,377,040

levels above the PRG in samples taken from Pit 3. The need for 2.6 m (8.5 ft) of clean soils is based on the assumption that the minimum depth of lead contamination in soil at WRRTF-01 is 0.5 m (1.5 ft).

At TSF-03, approximately 2.4 m (8 ft) of clean INEEL soils would be placed over the extent of the TSF-03 burn pit estimated to be an approximate 8 × 20 m (26 × 64 ft) area. The need for 2.4 m (8 ft) of clean soils is based on the assumption that 0.6 m (2 ft) of clean fill exists over the extent of the TSF-03 burn pit.

At TSF-08, approximately 2.3 m (7.5 ft) of clean INEEL soils would be placed over the area with soil concentrations exceeding the mercury PRG, estimated to be an approximate 21 × 3 m (40 × 10 ft) area. The need for 2.3 m (7.5 ft) of clean soils is based on the assumption that a minimum of 0.8 m (2.5 ft) of clean fill exists at TSF-08.

12.4.2.1 Overall Protection of Human Health and the Environment. This alternative is expected to be protective of human health and the environment. Providing 3 m (10 ft) of clean soil above contaminated areas combined with environmental monitoring and access restrictions would inhibit direct exposure to lead in soil at WRRTF-01 and TSF-03, and mercury in soil at TSF-08. Therefore, this alternative meets specified RAOs.

12.4.2.2 Compliance with ARARs. Table 12-1 presents the evaluation of the Native Soil Cover alternative for compliance with identified ARARs and TBCs. Compliance with the emissions control ARARs is ensured by performing excavation using water sprays and other techniques for dust suppression, as needed. Engineering controls for surface water runoff would insure compliance with 40 CFR 122.26 which regulates stormwater and associated discharges. DOE Orders would be met by implementing and enforcing applicable provisions of the Orders. Therefore, this alternative is capable of complying with all potential ARARs and TBCs identified.

12.4.2.3 Long-Term Effectiveness and Permanence. Providing 3 m (10 ft) of clean soils above contaminated areas and restricting activities conducted at WRRTF-01, TSF-03, and TSF-08 is expected to reduce risks associated with potential exposure to lead in soil at WRRTF-01 and TSF-03 and mercury in soil at TSF-08 by limiting direct contact with contaminated soils. Environmental monitoring, annual inspections, cover maintenance activities (if required), and five-year site reviews conducted for a period of 100 years would be conducted to monitor the long-term effectiveness and permanence of this alternative. Therefore, this alternative would likely provide for long-term and permanent reduction in risks associated with direct exposure to lead in soil at WRRTF-01 and TSF-03 and mercury in soil at TSF-08.

12.4.2.4 Reduction of Toxicity, Mobility, or Volume Through Treatment. This alternative does not involve treatment of contaminated soils. Therefore, there is no reduction of toxicity or volume with this alternative. Contaminant mobility would be reduced with the proposed cover.

12.4.2.5 Short-Term Effectiveness. Exposure to lead and mercury in soil during installation of a native soil cover would be minimized by the use of appropriate personal protective equipment, engineering controls, and adherence to INEEL health and safety protocols.

Nonexposure risks to workers are also a consideration during consolidation of surface soils (if necessary) and construction of the barriers. These risks result primarily from physical construction hazards, such as vehicle accidents or personal injuries. These hazards can be minimized by implementation of appropriate health and safety measures for earth-moving construction activities. RAOs would be achieved by this containment alternative once construction of the barrier is complete since health risk identified in the BRA would be below 1E–04.

Environmental impacts resulting from native soil cover construction activities would likely be minimal. The remoteness of the site would prevent any impact to the surrounding communities during construction activities. Installation of surface water diversion controls may result in alteration of the nearby terrain. However, the overall impact of these activities is not considered irreparable and would be minimal in the long term. No environmentally sensitive areas such as archaeological or historical sites, wetlands, or critical habitat exist in the vicinity of WRRTF-01, TSF-03, and TSF-08.

12.4.2.6 Implementability. This alternative is technically feasible at WRRTF-01, TSF-03, and TSF-08. The technologies associated with implementation of this alternative are readily available through previous applications at INEEL. There are no site-specific conditions that exist at WRRTF-01, TSF-03, and TSF-08 that would inhibit installation of the native soil cover, perimeter security fence installation, or annual inspection and environmental monitoring activities. The native soil cover design would likely be easily constructed. No specialized equipment or personnel would be necessary, and competitive bids could be easily obtained since a large number of construction firms are capable of performing the required work. Materials required for construction are anticipated to be available onsite at the INEEL. Clay, silt, and sand form the alluvial deposits in the northern portion of the INEEL could possibly be used to construct the native soil cap.

This alternative is administratively feasible. Long-term monitoring activities, maintenance of the soil cover (as necessary), and conducting five-year site reviews for a period of 100 years would require long-term coordination. However, this is not thought to present significant administrative difficulties.

12.4.2.7 Cost. The cost estimate developed for this alternative is based on constructing the native soil cover, installing a perimeter security fence, performing environmental monitoring and annual inspection and maintenance activities (as necessary), and conducting five-year site reviews for a period of 100 years. Post-closure costs were estimated for a 100-year maintenance and monitoring period. The estimated NPV for this alternative at WRRTF-01, TSF-03, and TSF-08 is shown in Table 12-11. The alternative cost estimates are for comparison purposes only and not intended for budgetary, planning, or funding purposes.

12.4.3 Alternative 3: Excavation and Off-Site Disposal

This alternative would involve excavation of soils above PRGs at WRRTF-01, TSF-03, and TSF-08 and transporting them off-site to an appropriate landfill. If the soils were determined to be hazardous according to applicable Resource Conservation and Recovery Act (RCRA) regulation, then they may be disposed at a RCRA-permitted hazardous waste landfill in Arlington, Virginia. If the excavated soils were determined to be nonhazardous according to applicable RCRA regulations, then they may be disposed at an appropriate solid waste landfill near Idaho Falls, Idaho. Compliance with appropriate waste characterization, transportation, and possible treatment requirements imposed by the off-site disposal facility would be required under this alternative.

Conventional excavation and transportation equipment and procedures would be used under this alternative. Potential health risks to workers during excavation would be minimized using standard administrative and engineering controls and appropriate personal protective equipment.

During excavation activities, all uncontaminated soils outside the hot spot areas would be stockpiled on-site and replaced into excavated areas following removal of contaminated soils. Verification sampling would be used to ensure that all contamination present at concentrations exceeding PRGs was removed. The excavated areas would be backfilled with clean soil after excavation. Institutional controls would not be required after site excavation and disposal, since all contamination would be removed and all exposure pathways would be eliminated. The details associated with implementation of this alternative for WRRTF-01, TSF-03, and TSF-08 are discussed in the following paragraphs.

At WRRTF-01, four distinct hot spot locations of lead contamination (one at Pit 1, one at Pit 2, and two at Pit 4) would be excavated. The lead hot spot at Pit 1 is assumed to be and area 1.2 m (4 ft) in diameter at a depth from 1.2 to 2.4 m (4 to 8 ft). The lead hot spot at Pit 2 is assumed to be an area 1.2 m (4 ft) in diameter at a depth from 1 to 2.7 m (3 to 9 ft). The first lead hot spot at Pit 4 is assumed to be an area 1.2 m (4 ft) in diameter at a depth from 2.7 to 3 m (9 to 10 ft). The second lead hot spot at Pit 4 is assumed to be an area 1.2 m (4 ft) in diameter at a depth from 0.5 to 3 m (1.5 to 10 ft). Composite samples would be taken from contaminated soils to determine the appropriate off-site disposal facility.

At TSF-03 the entire extent of the burn pit, assumed to be an approximate 8 × 20 m (26 × 64 ft) area, would be excavated. It is assumed that 0.6 m (2 ft) of clean fill exists over the extent of the burn pit. Therefore, the contaminated soils are assumed to be present at a depth from 0.6 to 3 m (2 to 10 ft). Composite samples would be taken from contaminated soils to determine the appropriate off-site disposal facility.

At TSF-08 two distinct hot spot locations of mercury contamination would be excavated. The first mercury hot spot at TSF-08 is assumed to be an area 1.2 m (4 ft) in diameter at a depth from 0.8 to 3 m (2.5 to 10 ft). The second mercury hot spot at TSF-08 is assumed to be an area 1.2 m (4 ft) in diameter at a depth from 0.8 to 3 m (2.5 to 10 ft). Composite samples would be taken from contaminated soils to determine the appropriate off-site disposal facility.

12.4.3.1 Overall Protection of Human Health and the Environment. This alternative is anticipated to provide highly effective, long-term protection of human health and the environment. The removal of lead-contaminated soil from WRRTF-01 and TSF-03, and mercury-contaminated soil at TSF-08 would eliminate potential long-term human health and environmental concerns associated with direct exposure to contaminants in soil at WRRTF-01, TSF-03, and TSF-08. Therefore, this alternative meets specified RAOs. The off-site disposal facility provides consolidation of the contaminated soils within a controlled disposal area where waste management and controls are in place and would be maintained for the period of institutional controls.

12.4.3.2 Compliance with ARARs and TBCs. Table 12-1 presents the evaluation of this alternative for compliance with the ARARs and TBCs. Compliance with the emissions control ARARs is ensured by performing excavation using water sprays and other techniques for dust suppression, as needed. This alternative would also comply with applicable portions of the Idaho Hazardous Waste Management Act through proper waste characterization, transportation, and disposal methods. 40 CFR 122.26, regulating stormwater and associated discharges, would be met by engineering controls on surface water

Table 12-11. Alternative 2: NPV for WRRTF-01, TSF-03, and TSF-08.

Site	NPV ($)
WRRTF-01	4,168,187
TSF-03	1,803,148
TSF-08	1,703,359

runoff. DOE Orders would be met by implementing and enforcing applicable provisions of the Orders. Therefore, this alternative is capable of complying with all potential ARARs and TBCs identified.

12.4.3.3 Long-Term Effectiveness and Permanence. This alternative provides for a long-term and permanent reduction in human health risks because lead-contaminated soils are completely removed at WRRTF-01 and TSF-03 and mercury-contaminated soils are completely removed at TSF-08 and consolidated in one location. The long-term risk to human health and the environment is basically transferred from the WRRTF-01, TSF-03, and TSF-08 to the off-site disposal facility. However, existing management practices at the off-site disposal facilities would be implemented to ensure minimal risks to human health and the environment.

12.4.3.4 Reduction of Toxicity, Mobility, or Volume Through Treatment. No treatment is directly specified under this alternative. However, depending on disposal facility requirements, contaminated soils may be required to be treated at the off-site disposal facility prior to disposal. If this were to occur, then there would likely be some reduction of toxicity, mobility or volume through treatment. If off-site treatment is not required prior to disposal then there would be no reduction of toxicity, mobility, or volume through treatment. However, contaminant mobility would be minimized at the disposal location through effective waste management practices.

12.4.3.5 Short-Term Effectiveness. Potential health risks to workers during excavation and removal of contaminated soils at WRRTF-01, TSF-03, and TSF-08 could be effectively mitigated using standard administrative and engineering controls including dust suppression and appropriate personal protective equipment (PPE).

Nonexposure risks to workers are also a consideration during excavation. These risks result primarily from physical construction hazards, such as vehicle accidents or personnel injuries. However, implementation of appropriate health and safety measures for the excavation activities can minimize these risks.

Environmental impacts resulting from this alternative are dependent on the remedial design and required access areas. The surrounding landscape would likely be disturbed because of the equipment and vehicles moving in and around the site. However, the impact of these activities would be temporary, and the entire site would be restored to match the surrounding landscape at the completion of the project. No environmentally sensitive archaeological or historical sites, wetlands, or critical habitat exist at WRRTF-01, TSF-03, or TSF-08.

RAOs would be achieved by this alternative once excavation and disposal at the off-site location is complete.

12.4.3.6 Implementability. This alternative is technically feasible at WRRTF-01, TSF-03, and TSF-08. Standard excavation and transportation equipment would be utilized to complete soil removal, transport to the off-site disposal facility for disposal, and backfilling/grading of excavated areas. The administrative feasibility of this alternative is considered high. Equipment and materials required for implementation of this alternative are readily available. Implementation of this alternative may be slightly more difficult due to the location of the off-site disposal facility with respect to INEEL. Coordination would be required between INEEL and disposal facility personnel to ensure disposal criteria are met before contaminated materials are excavated for off-site transport.

12.4.3.7 Cost. The costs of this alternative include conventional excavation and transportation of soils to an off-site disposal facility located in Arlington, Virginia, backfilling of excavated areas, and grading and revegetating the sites to natural conditions. The cost analysis for this alternative assumes that no post-closure monitoring or care is required. The estimated NPV of this alternative for WRRTF-01, TSF-03, and TSF-08 is summarized in Table 12-12. The alternative cost estimates are for comparison purposes only and not intended for budgetary, planning, or funding purposes.

12.4.4 Alternative 4a: Excavation and Treatment by Thermal Retort Off-Site

Due to its limited effectiveness on lead-contaminated soils, this alternative would be implemented only for the soils contaminated with mercury at levels above the PRG at TSF-08. This alternative would consist of excavating all soil contaminated with mercury at concentrations above the PRG; treating them off-site in a mercury retort (Bethlehem Apparatus in Pennsylvania); recycling recovered metallic mercury; and disposal of the treated soils at an appropriate off-site facility. Conventional excavation equipment would be used during excavation activities. Verification sampling would be used to ensure that all contamination present at concentrations exceeding PRGs was removed.

The thermal retort process has successfully treated soils at Central Facilities Area (CFA) and Test Area North (TAN) to levels that are below PRGs. The process would likely consist of heating the mercury-contaminated soil to approximately 1000°F and volatilizing the mercury into the vapor phase. This vapor phase would be passed through a condenser where the liquid mercury would be recovered or run through activated carbon canisters to adsorb the mercury. The clean treated soil would be disposed of appropriately by the off-site treatment facility (e.g., Bethlehem Apparatus) or if shown to be cost effective, shipped back to INEEL for replacement into excavated areas at TSF-08. Other treatment process options might potentially be selected in the ROD and/or during remedial design. No long-term environmental monitoring or institutional control (in addition to those currently conducted at TSF-08) would be required for TSF-08 after completion of the excavation and off-site treatment activities.

Two distinct hot spot locations of mercury contamination would be excavated at TSF-08. The first mercury hot spot at TSF-08 is assumed to be an area 1.2 m (4 ft) in diameter at a depth from 0.8 to 3 m (2.5 to 10 ft). The second mercury hot spot at TSF-08 is assumed to be an area 4 ft in diameter at a depth from 1.2 to 3 m (2.5 to 10 ft). During excavation activities, all uncontaminated soils outside the hot spot areas would be stockpiled on site and replaced into excavated areas following removal of mercury-contaminated soils. Clean INEEL soil would be used to backfill excavated areas to natural grade. If determined to be cost effective, the treated soils would be replaced into excavated areas. Areas impacted by excavation and stockpiling activities would be revegetated to natural conditions.

12.4.4.1 Overall Protection of Human Health and the Environment. This alternative is anticipated to provide highly effective, long-term protection of human health and the environment. The removal and off-site treatment of mercury-contaminated soil from TSF-08 would eliminate potential long-term human health and environmental concerns associated with direct exposure to mercury in soil. Therefore, this alternative meets specified RAOs.

Table 12-12. Alternative 3: NPV for WRRTF-01, TSF-03, and TSF-08.

Site	NPV ($)
WRRTF-01	12,518,392
TSF-03	1,352,293
TSF-08	810,942

12.4.4.2 Compliance with ARARs and TBCs. Table 12-1 presents the evaluation of this alternative for compliance with the ARARs and TBCs. Compliance with the emissions control ARARs is ensured by performing excavation using water sprays and other techniques for dust suppression, as needed. This alternative would also comply with applicable portions of the Idaho Hazardous Waste Management Act through proper waste characterization, transportation, and disposal methods. 40 CFR 122.26, regulating stormwater and associated discharges, would be met by engineering controls on surface water runoff. DOE Orders would be met by implementing and enforcing applicable provisions of the Orders. Therefore, this alternative is capable of complying with all potential ARARs and TBCs identified.

12.4.4.3 Long-Term Effectiveness and Permanence. This alternative provides for a long-term and permanent reduction in human health risks because mercury-contaminated soil is completely removed from TSF-08 and treated off-site to acceptable disposal levels. Existing treatment and disposal practices at the off-site disposal facility would be implemented to ensure minimal risks to human health and the environment.

12.4.4.4 Reduction of Toxicity, Mobility, or Volume Through Treatment. Treatment of mercury-contaminated soils via thermal retort would likely significantly reduce the volume of contaminated soils. Recycling or reuse of the recovered mercury by an industrial user would reduce the mobility in the environment. The thermal retort and recycling of mercury does not directly reduce the toxicity. However, contaminant mobility, toxicity, and volume would be eliminated at the individual OU 1-10 subsites.

12.4.4.5 Short-Term Effectiveness. Potential health risks to workers during excavation and removal of mercury-contaminated soil at TSF-08 could be effectively mitigated using standard administrative and engineering controls including dust suppression and appropriate PPE. As part of the off-site thermal retort process, emission control equipment and monitoring would be utilized during off-site treatment activities to minimize potential exposure to mercury contamination.

Nonexposure risks to workers are also a consideration during excavation. These risks result primarily from physical construction hazards, such as vehicle accidents or personnel injuries. However, implementation of appropriate health and safety measures for the excavation activities can minimize these risks.

Environmental impacts resulting from this alternative are dependent on the remedial design and required access areas. The surrounding landscape would likely be disturbed because of the equipment and vehicles moving in and around the site. However, the impact of these activities would be temporary, and the entire site would be restored to match the surrounding landscape at the completion of the project. No environmentally sensitive archaeological or historical sites, wetlands, or critical habitat exist at TSF-08.

RAOs would be achieved by this alternative once excavation, treatment, and disposal at the off-site location is complete.

12.4.4.6 Implementability. This alternative is technically feasible at TSF-08. Mercury retorting has been successfully implemented on soils from INEEL and has been shown to be capable of treating soils to levels below the mercury PRG and applicable soil disposal standards. The administrative feasibility is high. An off-site treatment facility with thermal retort capabilities has been identified in Pennsylvania. Additionally, industrial facilities willing to accept recovered mercury have also been identified. Excavation and soil transportation equipment are readily available. Implementation of this alternative may be slightly more difficult due to the location of the treatment and disposal facility with respect to the INEEL.

12.4.4.7 Cost. The costs of this alternative includes conventional excavation and transportation of soils to an off-site treatment facility (Bethlehem Apparatus) for thermal retorting, backfilling of excavated areas with clean INEEL soils (or treated soils if cost-effective), and grading and revegetating the site to natural conditions. The cost analysis for this alternative assumes that no post-closure monitoring or care is required. The alternative cost estimates are for comparison purposes only and not intended for budgetary, planning, or funding purposes. The estimated NPV of this alternative for WRRTF-01, TSF-03, and TSF-08 is summarized in Table 12-13.

12.4.5 Alternative 4b: Excavation and Soil Washing On-Site

Due to limited effectiveness for mercury-contaminated soils, this alternative would be implemented only for the lead-contaminated soils at WRRTF-01 and TSF-03. Under this alternative soils contaminated with lead at concentrations above the PRG would be excavated and treated on-site using a soil washing technology. A treatability study would be required to assess the optimal design parameters and treatment train for the soil washing process. For purposes of FS evaluations, the soil washing process would consist of an initial physical separation of the contaminated soils into fine- and coarse-grained fractions followed by an acid leach of the fine-grained fraction. The dissolved lead would be recovered using an ion exchange resin or through a typical chemical precipitation and filtration process. The recovered lead would be recycled appropriately or disposed at an off-site disposal facility if a lead recycling source is not identified.

The acid leach solution would be recycled in a closed loop process on-site as part of the treatment train. Depending on treatability study results, it may be more cost-effective to treat the reduced volume of lead-contaminated soils (after the physical separation step) using a stabilization technology rather than performing an acid leach. The stabilized lead-contaminated soils would be disposed of at a RCRA-permitted disposal facility in Arlington, Virginia. The coarse-grained fraction and the treated fines (assumed to meet lead PRGs) would be replaced into the excavated areas. The lead-contaminated soils from WRRTF-01 and TSF-03 would be composited and treated together in one soil washing treatment system.

Conventional excavation equipment would be used during excavation activities. During excavation, all uncontaminated soils outside the hot spot areas would be stockpiled on site and replaced into excavated areas following removal of lead-contaminated soils. Verification samples would be taken from excavated areas to assess if the extent of lead-contaminated soils were removed. Clean treated soils would be used to backfill excavated areas to natural grade. Areas impacted by excavation and treatment activities would be revegetated to natural conditions. The details associated with implementation of this alternative for WRRTF-01 and TSF-03 are discussed in the following paragraphs.

At WRRTF-01, four distinct hot spot locations of lead contamination (one at Pit 1, one at Pit 2, and two at Pit 4) would be excavated and treated using soil washing. The lead hot spot at Pit 1 is assumed to be and area 1.2 m (4 ft) in diameter at a depth from 1.2 to 2.4 m (4 to 8 ft). The lead hot spot at Pit 2 is assumed to be an area 1.2 m (4 ft) in diameter at a depth from 1 to 2.7 m (3 to 9 ft). The first lead hot spot at Pit 4 is assumed to be an area 1.2 m (4 ft) in diameter at a depth from 2.7 to 3 m (9 to 10 ft). The

Table 12-13. Alternative 4a: NPV for TSF-08.

Site	NPV ($)
TSF-08	5,715,156

second lead hot spot at Pit 4 is assumed to be an area 1.2 m (4 ft) in diameter at a depth from 0.5 to 3 m (1.5 to 10 ft).

At TSF-03 the entire extent of the burn pit, assumed to be approximately 8 × 20 m (26 × 64 ft), would be excavated and treated using soil washing. It is assumed that 0.6 m (2 ft) of clean fill exists over the extent of the burn pit. Therefore, the contaminated soils are assumed to be present at a depth from 0.6 to 3 m (2 to 10 ft).

12.4.5.1 Overall Protection of Human Health and the Environment. This alternative would likely provide for long-term overall protection of human health and the environment. The removal and treatment of lead-contaminated soil from WRRTF-01 and TSF-03 would eliminate potential long-term human health and environmental concerns associated with direct exposure to lead-contaminated soils. Therefore, this alternative potentially meets specified RAOs.

The effectiveness of soil washing in treating lead-contaminated soils to levels below PRGs would be evaluated through a soil washing treatability study.

12.4.5.2 Compliance with ARARs and TBCs. Table 12-1 presents the evaluation of this alternative for compliance with the ARARs and TBCs. Compliance with the Fugitive Dust (IDAPA 16.01.01650) Toxic Substances (IDAPA 16.01.01161) and Air Toxics (IDAPA 16.01.01585 and 16.01.01586) ARARs is ensured by performing excavation using water sprays and other techniques for dust suppression, as needed. This alternative would also comply with applicable portions of the Idaho Hazardous Waste Management Act through proper waste characterization, transportation, and disposal methods. 40 CFR 122.26, regulating stormwater and associated discharges, would be met by engineering controls on surface water runoff. DOE Orders would be met by implementing and enforcing applicable provisions of the Orders. Therefore, this alternative is capable of complying with all potential ARARs and TBCs identified.

12.4.5.3 Long-Term Effectiveness and Permanence. This alternative would likely provide for a long-term and permanent reduction in human health risks because lead-contaminated soil is completely removed from WRRTF-01 and TSF-03 and treated to acceptable levels using soil washing. The effectiveness of the soil washing process in treating lead-contaminated INEEL soils would be evaluated through a soil washing treatability study. Existing management practices at the off-site disposal facility would be continued to ensure minimal risks to human health and the environment.

12.4.5.4 Reduction of Toxicity, Mobility, or Volume Through Treatment. Treatment of lead-contaminated soils via soil washing would likely significantly reduce the volume of contaminated soils. Recycling of the recovered lead, or the continuation of existing management practices at the off-site disposal facility, would reduce the mobility in the environment. The soil washing process does not directly reduce the toxicity. However, contaminant mobility, toxicity, and volume would be eliminated at the individual sites.

12.4.5.5 Short-Term Effectiveness. Potential health risks to workers during excavation and soil washing of lead-contaminated soil at WRRTF-01 and TSF-03 could be effectively mitigated using standard administrative and engineering controls including dust suppression and appropriate personal protective equipment. Additionally, appropriate health and safety measures would be utilized during soil washing activities to minimize potential exposure to lead contamination.

Nonexposure risks to workers are also a consideration during excavation. These risks result primarily from physical construction hazards, such as vehicle accidents or personnel injuries. However, implementation of appropriate health and safety measures for the excavation activities can minimize these risks.

Environmental impacts resulting from this alternative are dependent on the remedial design and required access areas. The surrounding landscape would likely be disturbed because of the excavation and treatment equipment and vehicles moving in and around the site. However, the impact of these activities would be temporary, and the entire site would be restored to match the surrounding landscape at the completion of the project. No environmentally sensitive archaeological or historical sites, wetlands, or critical habitat exist at WRRTF-01 or TSF-03.

12.4.5.6 Implementability. This alternative has a moderate technical feasibility. The technical feasibility would depend highly on the results of the soil washing treatability study. Soil washing has been successfully implemented on soils from numerous lead-contaminated sites and has been shown to be capable of treating soils to levels below the lead PRG. However, soil washing of lead-contaminated soils has not been demonstrated at INEEL. The administrative feasibility is moderate to high. Standard excavation and soil washing equipment are readily available. A lead recycling facility would need to be identified to accept the recovered lead in the form of an ion exchange resin or filtercake from a lead precipitation process. If the recovered lead is not recycled it would require disposal at an off-site disposal facility located a significant distance from the INEEL (e.g., RCRA-permitted facility in Arlington, Virginia). This would require coordination between INEEL and the disposal facility personnel to ensure disposal criteria are met before contaminated materials are excavated for off-site transport.

12.4.5.7 Cost. The estimated costs for this alternative include excavating lead-contaminated soils, treating contaminated soils via soil washing, recycling of lead residuals (or transportation to an off-site disposal facility), backfilling/grading of excavated areas, and revegetating the sites to natural conditions. The cost analysis for this alternative assumes that no post-closure monitoring or care is required. The estimated NPV of this alternative for WRRTF-01 and TSF-03 are shown in Table 12-14. The alternative cost estimates are for comparison purposes only and not intended for budgetary, planning, or funding purposes.

12.4.6 Alternative 4c: Excavation and Land Farming

This alternative would only be implemented for the petroleum contaminated soils at WRRTF-13. Under this alternative, soils contaminated with petroleum concentrations that are greater than the TPH PRG (1,000 mg/kg; see Table 9-3) would be excavated and moved to the CFA Land Farm. At the CFA Land Farm, the soils would be spread on the ground and mixed to promote biological remediation of the

Table 12-14. NVP for Alternatives 4b and 4c.

Site	NPV ($)
WRRTF-01	13,343,729
TSF-03	4,919,397
WRRTF-13	829,055

a. Soil washing costs for WRRTF-01 soils are included in the TSF-03 total costs.

petroleum contamination. This biological remediation will occur naturally as long as aerobic conditions are maintained in the contaminated soil mass, so no treatment, other than periodic mixing, would be required to complete the remediation. The soils would be sampled periodically to ensure its petroleum contamination is being remediated, and the soil would be placed in the CFA Landfill, or used for fill material at other INEEL facilities, when its average TPH concentration reaches the TPH PRG.

Conventional excavation equipment would be used during all excavation activities. During excavation, all soils that are moved from areas outside of the petroleum contamination hot spots would be stockpiled on site and replaced in the excavation after removal of the petroleum contaminated soils is complete. Uncontaminated soil from an INEEL borrow location would be used to fill the excavation to grade.

The excavation would occur between buildings TAN-641 and TAN-645. In order to ensure the buildings will not be affected by the excavation, pilings would be used to support the excavation walls. As a result, the excavation would not require any side slope, and the only uncontaminated material that would need to be removed from the excavation would be the material that overlies the petroleum hot spots.

The maximum depth of excavation would be 3 m (10 ft). Removing contaminated soils to a depth of 3 m would ensure protection of human health and the environment at WRRTF-13, since conservative groundwater modeling performed as part of the OU 1-10 BRA (see Section 6) has predicted that the WRRTF-13 contamination will not produce any impacts to groundwater beneath the site.

WRRTF-13 contains three hotspot sources of petroleum contamination in the 0-3 m (0–10 ft) depth interval. These three sources are located from 1.5 to 3 m (5 to 10 ft) bgs under the former location of the TAN-738 to TAN-787 diesel transfer line, from 1.8 to 3 m (8 to 10 ft) bgs under the former location of tank TAN-738, and from 1.6 to 3 m (6 to 10 ft) bgs under the former location of tank TAN-739 (see Figure 4-40). The total volume of contaminated soil that may require removal from the site is estimated to be 290 m^3 (380 yd^3).

12.4.6.1 Overall Protection of Human Health and the Environment. This alternative would likely provide for long term overall protection of human health and the environment. The removal of petroleum contaminated soils to a depth of 3 m (10 ft) bgs would eliminate potential long term human health and environmental exposures to the site's contamination. As a result, this alternative would satisfy the specified RAOs for the site.

12.4.6.2 Compliance with ARARs and TBCs. Table 12-1 presents the evaluation of Alternative 4c for compliance with ARARs and TBCs. Compliance with the fugitive dust (IDAPA 16.01.01650), Toxic Substances (IDAPA 16.01.01161), and Air Toxics (IDAPA 16.01.01585 and 16.01.01586) ARARs would be ensured by performing all excavations with water sprays and other techniques for dust suppression, as needed. This alternative would also comply with applicable portions of the Idaho Hazardous Waste Management Act through proper waste characterization, transportation, and disposal methods. 40 CFR 122.26 regulations on stormwater and associated discharges would be met by engineering controls for surface water runoff. DOE Orders would be met by implementing and enforcing applicable provisions of the Orders. Therefore, this alternative is capable of complying with all identified ARARs and TBCs.

12.4.6.3 Long Term Effectiveness and Permanence. This alternative would likely provide for a long term and permanent reduction in potential risks associated with the site, because petroleum contaminated soils would be removed from the site and remediated using land farming techniques. The effectiveness of the land farming process would be evaluated by periodic sampling and monitoring of the contaminated soil after it is delivered to the CFA Land Farm. Existing management procedures at the CFA Land Farm would be continued to ensure minimal risks to human health and the environment as a result of the WRRTF-13 soil remediation.

12.4.6.4 Reduction of Toxicity, Mobility, and Volume Through Treatment. Treatment of petroleum contaminated soils through land farming would likely produce a significant reduction in the volume of contaminated soil associated with WRRTF-13. However, any contamination that remained in the soil after the land farming process was complete would probably have the same toxicity and mobility characteristics as the original contamination.

12.4.6.5 Short Term Effectiveness. Potential health risks of petroleum contaminated soil at WRRTF-13 could be effectively mitigated using standard excavation and land farming administrative and engineering controls. These controls would include dust suppression and the use of appropriate personal protective equipment. Physical risks to workers during excavation operations would be minimized through the use of appropriate standard health and safety measures.

Impacts to the environment and existing structures at WRRTF that would be produced by implementation of this alternative would be dependent on the alternative's remedial design. The landscape around WRRTF-13 would be disturbed by the excavation activities and movement of heavy equipment around the site, and the excavation activities would produce a potential for structural damage to buildings TAN-641 and TAN-645. However, the impacts to the area's landscape and the potential for damage to the area's buildings would be temporary, since the site would be restored to its original condition after the excavation activities were completed.

No environmentally sensitive archeological or historical sites, wetlands, or critical habitat are known to exist at WRRTF-13.

12.4.6.6 Implementation. This alternative has a moderate to high technical feasibility. Land farming of petroleum contaminated soils has been used successfully to remediate contamination produced by other INEEL releases, so it is likely to be successful on the WRRTF-13 soils. The administrative feasibility of the alternative would also be moderate to high, since standard excavation equipment is readily available, and since CFA already has an area where land farming has been performed in the past.

12.4.6.7 Cost. The estimated costs associated with this alternative would include costs for excavation of the WRRTF-13 contaminated soils, costs for transportation of the soils to CFA, and costs for transfer of clean soil to the WRRTF-13 excavation. The cost analysis for this alternative assumes that no post-closure monitoring or care would be required. The estimated NPV of this alternative is shown in Table 12-14.

12.4.7 Summary of Individual Analyses for Nonradionuclide-Contaminated Soils

Table 12-15 summarizes the detailed analysis for OU 1-10 nonradionuclide-contaminated sites. The total NPV estimated for the alternative was not included on Table 12-15 due to the variation in subsites addressed by each alternative.

12.5 Comparative Analysis of Alternatives for Nonradionuclide-Contaminated Soils

The comparative analysis provides a measure of the relative performance of alternatives against each evaluation criterion. The purpose of this comparison is to identify the relative advantages and disadvantages associated with each alternative. The comparative analysis does not identify a preferred alternative, but provides sufficient information to enable this selection by the appropriate decision makers (DOE-ID, EPA, and IDHW). The following sections present the alternative comparisons relative to each evaluation criterion, for each grouping of sites. Table 12-16 summarizes how each alternative satisfies the RAOs identified in Section 9.1. Table 12-17 summarizes the relative ranking of alternatives.

Each of the evaluation criteria are discussed in the following subsections.

12.5.1 Overall Protection of Human Health and the Environment

The primary measure of this criterion is the ability of an alternative to achieve RAOs. Table 12-16 provides a summary of the comparison of alternatives with RAOs. Alternative 1 (No Action/Limited Action) and Alternative 2 (Native Soil Cover) meet RAOs; however, long-term maintenance and monitoring are required to ensure that RAOs continue to be met. Alternatives 3 meets RAOs; however, there is some degree of long-term management and liability associated with off-site disposal of contaminated soils. Alternatives 4a, 4b, and 4c both meet RAOs and do not require any long-term maintenance or monitoring activities. Therefore, Alternatives 1, 2, and 3 are similarly ranked lower than Alternatives 4a, 4b, and 4c.

12.5.2 Compliance with ARARs

Each of the alternatives evaluated for nonradionuclide-contaminated soils would likely meet the potential ARARs or TBCs triggered by each alternative. Therefore, all are equally ranked with respect to compliance with ARARs.

12.5.3 Long-Term Effectiveness and Permanence

Alternative 3 (Excavation and Off-site Disposal) provides the highest degree of long-term effectiveness and permanence for lead-contaminated soils at WRRTF-01 and TSF-03, because contaminated soil is removed from the site and placed in a managed off-site disposal unit. However, if a soil washing treatability study were to show favorable results, Alternative 4b (Excavation and Soil Washing On-Site) would likely have the greatest long-term and permanent reduction in risk at WRRTF-01 and TSF-03. Alternative 4a (Excavation and Treatment by Thermal Retort Off-Site) provides the greatest long-term effectiveness and permanence for TSF-08 because mercury-contaminated soils are both removed and treated to below applicable standards. Alternative 4c (Excavation and Land Farming) provides the greatest long-term effectiveness and permanence for WRRTF-13, because the alternative removes and treats all contamination to below applicable standards. Alternative 2 (Native Soil Cover) and Alternative 1 (No Action/Limited Action) are ranked slightly lower than Alternatives 3, 4a, 4b, and 4c because the inherent hazards of the soil would remain.

Table 12-15. Detailed analysis summary for OU 1-10 nonradionuclide-contaminated sites.

Criteria	Alternative 1 No Action/Limited Action	Alternative 2 Native Soil Cover	Alternative 3 Excavation and Off-site Disposal	Alternative 4a Excavation and Treatment by Thermal Retort Off-Site	Alternative 4b Excavation and /Soil Washing	Alternative 4c Excavation and Land Farming
Overall protection of human health and the environment						
Human health protection	Reduction in risk due to access restrictions and ongoing monitoring/ maintenance through institutional control period.	Soil cover would prevent direct exposure to contaminated soil and debris. Minimal exposure risks during cover construction.	Eliminates potential exposure from contaminated soil at site. Protectiveness is based on completely removing contaminated soils from site. Short-term risk is low.	Eliminates potential exposure from contaminated soil at site. Protectiveness is based on completely removing mercury contamination from site. Short-term risk is low.	Eliminates potential exposure from contaminated soil at site. Protectiveness is based on completely removing lead-contaminated soils from site. Short-term risk is low.	Eliminates potential exposure from contaminated soil at the site. Protectiveness is dependent on effectiveness of the land farming process. Short term risk is low.
Environmental protection	Migration of contaminated soil by surface water erosion limited with engineering controls.	Provides protection from direct exposure to contaminated soil and debris for the lifetime of the cap. Minimal environmental impacts during construction.	Eliminates contamination from site.	Eliminates contamination from site.	Eliminates contamination from site.	Eliminates contamination from the site.
Compliance with ARARs						
Action-specific						
Idaho Fugitive Dust Emissions—IDAPA 16.01.01650 et seq.	Would meet ARAR based on modeled BRA results	Would meet ARAR by eliminating potential for windblown soil contamination	Would meet ARAR by eliminating potential for windblown soil contamination	Would meet ARAR by eliminating potential for windblown soil contamination	Would meet ARAR by eliminating potential for windblown soil contamination	Would meet ARAR by eliminating potential for windblown soil contamination
Toxic Substances—IDAPA 16.01.01161	Would meet ARAR based on modeled BRA results	Would meet ARAR by eliminating potential for windblown soil contamination	Would meet ARAR by eliminating potential for windblown soil contamination	Would meet ARAR by eliminating potential for windblown soil contamination	Would meet ARAR by eliminating potential for windblown soil contamination	Would meet ARAR by eliminating potential for windblown soil contamination

Table 12-15. (continued).

Criteria	Alternative 1 No Action/Limited Action	Alternative 2 Native Soil Cover	Alternative 3 Excavation and Off-site Disposal	Alternative 4a Excavation and Treatment by Thermal Retort Off-Site	Alternative 4b Excavation and /Soil Washing	Alternative 4c Excavation and Land Farming
Idaho Hazardous Waste Management Act—IDAPA 16.01.05.004 16.01.05.005 16.01.05.006 16.01.05.008 16.01.05.011	Not ARAR	Not ARAR	Would meet ARAR through proper waste characterization, transportation and disposal methods.	Would meet ARAR through proper waste characterization, transportation and disposal methods.	Would meet ARAR through proper waste characterization, transportation and disposal methods.	Would meet ARAR through proper waste characterization, transportation and disposal methods.
Chemical-specific						
Rules for the Control of Air Toxics in Idaho (Air Toxics Rules)—IDAPA 16.01.01585 and 16.01.01586	Not ARAR	Not ARAR	Would meet ARAR through use of water sprays or other engineering controls during excavation.	Would meet ARAR through use of water sprays or other engineering controls during excavation.	Would meet ARAR through use of water sprays or other engineering controls during excavation.	Would meet ARAR through use of water sprays or other engineering controls during excavation.
Safe Drinking Water Act—40 CFR 141	Not ARAR, no threat to groundwater or surface water.	Not ARAR, no threat to groundwater or surface water.	Not ARAR, no threat to groundwater or surface water	Not ARAR, no threat to groundwater or surface water.	Not ARAR, no threat to groundwater or surface water.	Not ARAR, no threat to groundwater or surface water.
Location-specific						
National Historic Preservation Act— 16 USC 470 et seq.	Not ARAR, all activities would occur outside designated areas.	Not ARAR, all activities would occur outside designated areas.	Not ARAR, all activities would occur outside designated areas.	Not ARAR, all activities would occur outside designated areas.	Not ARAR, all activities would occur outside designated areas.	Not ARAR, all activities would occur outside designated areas.
Storm Water Discharges—40 CFR 122.26	Would not meet ARAR because no controls would be implemented.	Would meet ARAR through use of engineering controls.	Would meet ARAR through use of engineering controls	Would meet ARAR through use of engineering controls.	Would meet ARAR through use of engineering controls.	Would meet ARAR through use of engineering controls.

Table 12-15. (continued).

Criteria	Alternative 1 No Action/Limited Action	Alternative 2 Native Soil Cover	Alternative 3 Excavation and Off-site Disposal	Alternative 4a Excavation and Treatment by Thermal Retort Off-Site	Alternative 4b Excavation and /Soil Washing	Alternative 4c Excavation and Land Farming
TBCs						
Environmental Protection, Safety and Health Protection Standards--DOE Order 5480.4	Would meet TBC through controls which would be implemented.	Would meet TBC through use of engineering and institutional controls and best management practices.	Would meet TBC through use of engineering and institutional controls and best management practices.	Would meet TBC through use of engineering and institutional controls and best management practices.	Would meet TBC through use of engineering and institutional controls and best management practices.	Would meet TBC through use of engineering and institutional controls and best management practices.
Long-term effectiveness and permanence						
Magnitude of residual risk	Some reduction in existing risk due to institutional controls. Inherent hazards of soil would remain.	Source-to-receptor pathways eliminated while cover remains in place. Inherent hazards of soil would remain.	No residual risk would remain at subsites.	No residual risk would remain at subsites.	No residual risk would remain at subsites. Treatability study would be required to verify this assumption.	No residual risk would remain at the site.
Adequacy and reliability of controls	Limited access to contaminated soil effective only during institutional control period.	Limited access to contaminated soil and environmental monitoring effective only during institutional period of control (100 years).	Off-site disposal facility is assumed to provide adequate and reliable control over disposed soil and debris for the period of institutional controls	Use of PPE and engineering controls would likely be adequate	Use of PPE and engineering controls would likely be adequate	Use of PPE and engineering controls would likely be adequate
Reduction of toxicity, mobility, or volume through treatment						
Treatment process used	Not applicable.	Not applicable.	Not applicable	Thermal retort.	Soil washing	Land farming
Amount destroyed or treated	Not applicable.	Not applicable.	Not applicable	All contaminants	All contaminants	All contaminants
Reduction of toxicity, mobility, or volume	Not applicable.	Mobility reduced.	Mobility reduced.	High	High	High

Table 12-15. (continued).

Criteria	Alternative 1 No Action/Limited Action	Alternative 2 Native Soil Cover	Alternative 3 Excavation and Off-site Disposal	Alternative 4a Excavation and Treatment by Thermal Retort Off-Site	Alternative 4b Excavation and /Soil Washing	Alternative 4c Excavation and Land Farming
Irreversible treatment	Not applicable.	Not applicable.	Not applicable	High	High	High
Type and quantity of residuals remaining after treatment	Not applicable.	Not applicable.	Not applicable	Mercury for recycle	Lead for recycle	Not applicable
Statutory preference for treatment	Not applicable.	Not applicable.	Not applicable	Met.	Met.	Met.
Short-term effectiveness						
Community protection	No increase in potential risks to the public.	No increase in potential risks to the public.	No increase in potential risks to the public	No increase in potential risks to the public.	No increase in potential risks to the public.	No increase in potential risks to the public.
Worker protection	No increase in potential risk to workers.	Worker risk during soil cover installation minimized through the use of PPE and engineering controls.	Worker risk from exposure to contaminated soil minimized through the use of PPE and engineering controls	Worker risk from exposure to contaminated soil minimized through the use of PPE and engineering controls	Worker risk from exposure to contaminated soil minimized through the use of PPE and engineering controls	Worker risk from exposure to contaminated soil minimized through the use of PPE and engineering controls
Environmental impacts	No change from existing conditions.	Limited to disturbances from vehicle and material transport activities associated with native soil cover construction. Limited potential for airborne contamination in the form of fugitive dust, due to use of water sprays.	Limited to disturbances from vehicle and material transport activities associated with excavation. Limited potential for airborne contamination in the form of fugitive dust, due to use of water sprays.	Limited to disturbances from vehicle and material transport activities associated with excavation. Limited potential for airborne contamination in the form of fugitive emissions, due to use of water sprays or other engineering controls.	Limited to disturbances from vehicle and material transport activities associated with excavation. Limited potential for airborne contamination in the form of fugitive dust, due to use of water sprays.	Limited disturbances from vehicle and material transport activities. Limited potential for structural damage to buildings surrounding WRRTF-13.

Table 12-15. (continued).

Criteria	Alternative 1 No Action/Limited Action	Alternative 2 Native Soil Cover	Alternative 3 Excavation and Off-site Disposal	Alternative 4a Excavation and Treatment by Thermal Retort Off-Site	Alternative 4b Excavation and /Soil Washing	Alternative 4c Excavation and Land Farming
Time until action is complete	Not applicable.	To be determined during remedial design phase.	To be determined during remedial design phase.	To be determined during remedial design phase.	To be determined during remedial design phase.	To be determined during remedial design phase.
Implementability						
Ability to construct and operate	Long-term management and monitoring of sites required. Access restrictions may be administratively difficult to obtain.	Involves available construction technology.	Involves available construction technology; however, moderate due to safety requirements.	Involves available construction technology; however, moderate due to safety requirements.	Involves available construction technology; however, moderate due to safety requirements and need for treatability study.	Involves available construction technology; however, moderate due to safety requirements.
Ease of implementing additional action if necessary	May require repeat of feasibility study/record of decision process.	Additional remedial actions would be difficult, as the soil cover is intended to prevent access to contamination. Cover would require removal.	No additional remedial action would be necessary, as all contaminated soil is removed.	No additional remedial action would be necessary, as all contaminated soil is removed.	No additional remedial action would be necessary, as all contaminated soil is removed.	No additional remedial action would be necessary, as all contaminated soil is removed.
Ability to monitor effectiveness	Conditions at site are easily monitored.	Soil cover performance can be monitored through sampling and can be visually assessed on the basis of physical integrity.	The effectiveness in removing all contaminated materials associated with site is easily monitored.	The effectiveness in removing all contaminated materials associated with site is easily monitored.	The effectiveness in removing all contaminated materials associated with site is easily monitored.	The effectiveness in removing all contaminated materials associated with site is casily monitored.
Ability to obtain approvals and coordinate with regulatory agencies	No approvals required.	No difficulties identified.	No difficulties identified.	No difficulties identified.	Would require coordination with regulatory agencies for on-site treatment and disposal.	No difficulties identified.

Table 12-15. (continued).

Criteria	Alternative 1 No Action/Limited Action	Alternative 2 Native Soil Cover	Alternative 3 Excavation and Off-site Disposal	Alternative 4a Excavation and Treatment by Thermal Retort Off-Site	Alternative 4b Excavation and /Soil Washing	Alternative 4c Excavation and Land Farming
Availability of services and capacity	None required.	Soil cover design and services reside within the DOE and are considered readily available to the INEEL.	Services available either onsite, through subcontractor, or at off-site location.	Services available either onsite, through subcontractor, or at off-site location.	Services available either onsite or through subcontractor.	Services available either onsite or through subcontractor.
Availability of equipment, specialists, and materials	Readily available for access restrictions and environmental monitoring.	Equipment and materials are readily available at the INEEL or within surrounding communities.	Equipment and materials are either available onsite through subcontractors or would be purchased. Trained specialists are available within the communities surrounding the INEEL.	Equipment and materials are either available onsite through subcontractors or would be purchased. Trained specialists are available within the communities surrounding the INEEL.	Equipment and materials are either available onsite through subcontractors or would be purchased. Trained specialists are available within the communities surrounding the INEEL.	Equipment and materials are either available onsite through subcontractors or would be purchased. Trained specialists are available within the communities surrounding the INEEL.
Availability of technology	None required	Readily available at the INEEL.	Readily available at the INEEL and the off-site disposal facility.	Readily available at the INEEL and at the treatment facility in Bethlehem Apparatus.	Readily available at the INEEL or within surrounding communities.	Readily available at the INEEL or within surrounding communities.
Net Present Value						
	See detailed analysis	See detailed analysis	See detailed analysis	See detailed analysis	See detailed analysis	See detailed analysis

Table 12-16. Comparison of alternatives with RAOs.

Criteria	Alternative 1 No Action/Limited Action	Alternative 2 Native Soil Cover	Alternative 3 Excavation/Off-site Disposal	Alternative 4a Excavation/Thermal Retort	Alternative 4b Excavation/Soil Washing	Alternative 4c Excavation and Land Farming
RAOs for contaminated soil						
Prevention of direct exposure	Inhibits direct exposure to contaminated soils by imposing access restrictions.	Inhibits direct exposure to contaminated soils through providing a 3 m (10 ft) thick cover over contaminated areas.	Eliminates potential exposure by removing contamination.	Eliminates potential exposure by removing and treating contamination at TSF-08.	Eliminates potential exposure by removing and treating contamination at WRRTF-01 and TSF-03.	Eliminates exposure by removing and treating contamination at WRRTF-13.
Prevention of ingestion/homegrown produce ingestion	Ingestion inhibited by imposing access restrictions	Ingestion prevented by isolating contamination beneath a protective cover.	Eliminates potential ingestion, homegrown produce uptake/ingestion by removing contamination.	Eliminates potential ingestion, homegrown produce uptake/ingestion by removing and treating contamination at TSF-08.	Eliminates potential ingestion by removing treating contamination at WRRTF-01 and TSF-03.	Eliminates exposure by removing and treating contamination at WRRTF-13.

Table 12-17. Summary of comparative analysis of alternatives.

Criterion	Alternative 1: No Action/Limited Action	Alternative 2: Native Soil Cover	Alternative 3: Excavation and Off-site Disposal	Alternative 4a: Excavation and Treatment by Off-Site Thermal Retort (for TSF-08 only)	Alternative 4b: Excavation and On-Site Soil Washing (for WRRTF-01 and TSF-03 only)	Alternative 4c: Excavation and Land Farming (for WRRTF-13 only)
Overall protection of human health and the environment	0	0	0	+	+	+
Compliance with ARARs	+	+	+	+	+	+
Long-term effectiveness and permanence	0	0	+	+	+	+
Reduction of toxicity, mobility, or volume through treatment	–	0	0	+	+	+
Short-term effectiveness	+	0	–	–	–	–
Implementability	+	0	0	0	0	0
Cost	0	–	+	0	0	+

+ Favorable relative ranking

0 Neutral relative ranking

Unfavorable relative ranking

12.5.4 Reduction of Toxicity, Mobility, or Volume through Treatment

Alternatives 1 and 2 do not involve direct treatment of contaminated soils; therefore, there is no reduction of toxicity or volume of contamination associated with these alternatives. There is no reduction in contaminant mobility with Alternative 1, however, there would be reduction in mobility achieved with Alternative 2. Therefore, Alternative 2 is higher ranked than Alternative 1. Alternative 3 (Excavation and Off-site Disposal) may involve some off-site treatment if disposal facility standards require it. Therefore, there may be some reduction of toxicity, mobility, or volume associated with Alternative 3. Alternative 3 would achieve reduction in mobility through the continuation of existing management practices at the off-site disposal facility. Alternatives 3, 4a, 4b, and 4c eliminate toxicity, mobility, and volume at the OU 1-10 subsites. However, Alternatives 4a, 4b, and 4c both involve direct treatment of contaminated soils and thus have the highest level of reduction of toxicity, mobility, or volume through treatment.

12.5.5 Short-Term Effectiveness

Alternative 1 (No Action/Limited Action) would likely result in no significant impacts to worker health and safety or the environment. Therefore, this alternative has the highest degree of short-term effectiveness. Alternative 2 (Native Soil Cover) is lower ranked than Alternative 1 because there would be some short-term environmental impacts associated with construction of a 3-m (10-ft) thick native soil cover at WRRTF-01, TSF-03, and TSF-08. Alternative 3 (Excavation and Off-site Disposal) is lower ranked than Alternative 2 because in addition to short-term environmental impacts, there may be increased worker exposure to contaminants in soil associated with excavation and disposal activities. Alternatives 4a (Excavation and Treatment by Thermal Retort Off-Site), 4b (Excavation and Soil Washing On-Site), and 4c (Excavation and Land Farming) are considered the least effective for short-term protection. A significant amount of handling of contaminated soils and treatment residuals would be required with these alternatives.

12.5.6 Implementability

Alternative 1 (No Action/Limited Action) has the highest degree of technical and administrative feasibility because no remedial action is conducted under that alternative. Installation of a perimeter security fence and imposing legal restriction are not anticipated to pose significant technical or administrative difficulties. Alternative 2 (Native Soil Cover) is lower ranked than Alternative 1 because of the higher degree of difficulty associated with installation of a 10 ft thick native soil cover. Alternative 3 (Excavation and Off-site Disposal) is slightly lower ranked than Alternative 2 due to the additional requirements associated with excavation, handling, and off-site disposal of contaminated soils. Alternatives 4a and 4b are the lowest ranked alternatives with respect to implementability. Alternative 4a (Excavation and Treatment by Thermal Retort Off-Site) has been shown to be effective at reducing mercury concentrations in INEEL soils to levels below the PRG. However, the administrative feasibility is moderate due to the distance required to ship mercury-contaminated soils to the off-site treatment facility (Bethlehem Apparatus in Pennsylvania). Alternative 4b (Excavation and Soil Washing) is more difficult to implement because of the complexity of the remediation process, however the individual technologies specified for Alternative 4b are available and have been demonstrated. A soil washing treatability study would have to be conducted on INEEL soils to further evaluate its technical feasibility. Alternative 4c (Excavation and Land Farming) has a moderate to high implementability because all of the equipment necessary for implementation of the alternative is readily available, and because land farming has been successfully used to remediate petroleum contaminated soils from other INEEL release sites.

12.5.7 Cost

The level of detail used to develop the cost estimates presented is considered appropriate for comparing alternatives. Separate cost line items are developed for the primary components of each remedial action alternative, such as monitoring; capping; excavation; disposal; and reporting requirements such as remedial design/remedial action scope of work, remedial design/remedial action work plans, safety documentation, and progress reports.

The level of detail presented in the cost estimates is consistent with the level of detail provided in the descriptions of each alternative. Additional details in the cost estimates are not considered appropriate without supporting detailed designs for each alternative. The uncertainty associated with each cost estimate increases with the complexity of the alternative.

The results of the comparative analysis of costs for each subsite include the following:

- WRRTF-01—Costs associated with Alternatives 3 and 4b are relatively equivalent and were the highest for this subsite. Alternatives 2 has a slightly higher cost than Alternative 1.

- TSF-03—Costs associated with Alternative 3 are the lowest for this subsite. Alternative 1 has a slightly higher cost than Alternative 3, and Alternative 2 is higher in cost than Alternative 1. Alternative 4b has the highest cost for this subsite.

- TSF-08—Costs associated with Alternative 3 are the lowest for this subsite. Alternative 4a has a higher cost than Alternative 3, and Alternative 1 costs are higher than Alternative 3. Alternative 2 has the highest costs for this subsite.

- WRRTF-13—Costs associated with Alternative 4c are the lowest for this subsite, compared to Alternative 1.

12.5.8 Summary of Comparative Analysis of Alternatives

A summary of the comparative analysis of remedial action alternatives for nonradionuclide-contaminated sites of concern within OU 1-10 is provided in Table 12-17. Relative rankings were assigned to each alternative based on the various evaluation criteria. A value of "+" indicates a favorable ranking relative to other alternatives for that criteria. A value of "0" indicates a neutral relative ranking and a value of "–" indicates an unfavorable ranking relative to other alternatives.

12.6 Individual Analysis of Alternatives for TSF-26

In accordance with CERCLA RI/FS guidance, remedial action alternatives retained for detailed analysis are individually assessed against the evaluation criteria listed in Section 12.1, not including state and community acceptance. The individual analysis of each alternative developed to address tank waste liquids, sludge, and contaminated soils at TSF-26 (PM-2A V-13 and PM-2A V-14) is discussed in the following subsections.

12.6.1 Alternative 1: No Action/Limited Action

The No Action/Limited Action alternative is presented to comply with requirements of the NCP [40 CFR 300.430 (e)(6)] and guidance for conducting feasibility studies under CERCLA (EPA 1988). The No Action/Limited Action alternative provides a baseline with which other alternatives can be compared. Under this alternative, existing management practices currently in place at TSF-26 would be continued with the addition of expanded environmental monitoring and the implementation of institutional controls.

Existing management practices include environmental monitoring in accordance with INEEL site-wide requirements under the RESP and SESP. Monitoring activities may consist of the collection and analysis of air, groundwater, soil, biota, and other media from the site as applicable. Air monitoring may include the use of high- and low-volume air samplers to determine if fugitive radionuclides escape sites where contaminated surface soils exist. Groundwater monitoring may include monitoring contaminant migration in groundwater beneath the site. Soil monitoring would include radiation surveys over and around sites where contaminated soil and debris are left in place, to evaluate if contaminants have been mobilized to the surface.

Institutional controls implemented at these subsites would consist of restricting access to the sites using controls such as fencing and legal land-use restrictions. Surface water diversion controls would also be implemented as appropriate. In addition, five-year site reviews would be conducted to evaluate the effectiveness of the institutional controls and the need for further environmental monitoring, or additional control measures, as applicable. Five-year site reviews would be conducted for a duration of 100 years. The details associated with implementation of this alternative for TSF-26 are discussed in the following paragraph.

At TSF-26, environmental monitoring would be continued. Current management practices such as restricting activities conducted at TSF-26 without clearance from the INEEL ER directorate would also be continued. A perimeter security fence with appropriate signage would be installed around the portion of TSF-26 with soil concentrations above PRGs.

12.6.1.1 Overall Protection of Human Health and the Environment. Under the No Action/Limited Action alternative, human health and environmental risks and would be reduced in the short-term by preventing direct exposure to radionuclides in soils and tank contents at TSF-26. Continuation of environmental monitoring, installation of a perimeter security fence and imposing legal restrictions meets specified RAOs and provides for overall protection of human health and the environment in the short-term at TSF-26. However, due to uncertainties associated with the integrity of the tanks, the No Action/Limited Action alternative would most likely not meet RAOs and provide for protection of human health and the environment in the long-term.

12.6.1.2 Compliance with ARARs and TBCs. Table 12-1 presents the evaluation of the No Action/Limited Action alternative for compliance with the ARARs and TBCs. This alternative does not involve any construction or operational activities that would result in disturbances to the surfaces at TSF-26. IDAPA 16.01.01650 could nonetheless apply to the subsites if they were a source of fugitive dust. However, modeled BRA results indicate that this ARAR would be met. IDAPA 16.01.01161 would also be met by this alternative. 40 CFR 122.26, regulating stormwater and associated discharges, would similarly apply. Health risks to current workers would be within acceptable ranges under this alternative. In addition, this alternative would meet DOE Orders because health risks to potential future workers and residents would be within allowable ranges.

12.6.1.3 Long-Term Effectiveness and Permanence. This alternative does not provide for long-term and permanent control of human and environmental exposure to radionuclide-contaminated soils at TSF-26. This alternative provides some long-term control of human and environmental contact with contaminated soils, but provides no measures to prevent release of contaminants from the tanks. Therefore, since potential releases of contaminants from the tanks are not prevented, the long-term effectiveness and permanence of the limited action alternative is considered low.

12.6.1.4 Reduction of Toxicity, Mobility, or Volume Through Treatment. No treatment is associated with this alternative. Toxicity, mobility, and volume of contaminated soils would remain unchanged.

12.6.1.5 Short-Term Effectiveness. This alternative can be readily implemented without additional risks to the community, workers, or the environment. No specialized equipment, personnel, or services are required to implement the limited action alternative. The short-term effectiveness of this alternative is considered high.

12.6.1.6 Implementability. This alternative is technically feasible and has a moderate administrative feasibility. There are no site-specific conditions that exist at TSF-26 that would inhibit environmental monitoring or perimeter security fence installation activities. However, long-term management and monitoring would be required. Although not anticipated, if opposition to access restrictions occurs, gaining approval of access restrictions could be administratively difficult. Equipment and materials required for implementation of this alternative are readily available. Implementability of the No Action/Limited Action alternative is considered high.

12.6.1.7 Cost. The costs associated with the No Action/Limited Action alternative include installation of a perimeter security fence, installation of surface water diversion controls, imposing legal restrictions, conducting periodic monitoring activities, and conducting five-year site reviews for a period of 100 years. Estimated NPVs are shown in Table 12-18 for each subsite. Post-closure costs were estimated for a 100-year monitoring period. The alternative cost estimates are for comparison purposes only and not intended for budgetary, planning, or funding purposes.

12.6.2 Alternative 2: Soil Excavation, Tank Removal, Ex Situ Treatment and Disposal

Three alternatives were developed to address contaminated soils and tank waste at TSF-26 which involve soil excavation, tank removal, ex-situ treatment and disposal:

- Excavate contaminated soils, excavate tanks and their contents, treat tank contents on-site, and dispose of the treated material at Radioactive Waste Management Complex (RWMC) and excavated soils at the proposed ER INEEL soil repository or RWMC.

Table 12-18. Alternative 1: NPV for TSF-26.

Site	NPV ($)
TSF-26 (PM-2A V-13 and V-14)	1,429,760

- Excavate contaminated soils, excavate tanks and their contents, treat tank contents on-site, and dispose of the treated material and excavated soils off-site at a commercial low-level radioactive waste disposal facility.

- Excavate contaminated soils, excavate tanks and their contents, place all excavated materials in high integrity containers, transport off-site for treatment and disposal.

The soil excavation, tank removal, ex situ treatment, and disposal alternatives are discussed in the following subsections:

12.6.2.1 Alternative 2a: Soil Excavation, Tank Removal, and On-site Treatment and Disposal. Alternative 2a would consist of excavation of the tanks and their contents, solidification of the dewatered tank contents, disposal of the excavated soils on-site at the proposed ER INEEL soil repository or RWMC, and disposal of the treated tank contents at the RWMC. The tanks and contaminated soils surrounding the tanks would be removed using standard excavation equipment. Tank contents would be removed remotely by jetting and pumping, or vacuum removal and the tanks would be decontaminated in-place prior to removal. Tank wastes would be dewatered to extract liquids introduced during removal operations, and all wastes determined to have a classification greater than Class A would be treated to create a stable waste form. The treated waste must conform to the U.S. Nuclear Regulatory Commission's (NRC's) Branch Technical Position on Waste Form which specifies limits on the leachability of contaminants and the structural stability of the material. Liquid generated during excavation and dewatering activities, if any, would be characterized and disposed of appropriately at the Idaho Chemical Processing Plant (ICPP) process equipment waste (PEW) System.

Conventional excavation and transportation equipment and procedures would be used under this alternative. Supplied air and shielding in the form of leaded windows and lead lining on exterior facing surfaces of the equipment would be used as needed. Excavation equipment modified with positive-pressure ventilation system cabs and HEPA filters for use in radioactively-contaminated areas is available at the INEEL from previous remedial actions. If not available onsite, excavation equipment may be supplied by a subcontractor or may be purchased from vendors. However, modification of subcontractor or purchased equipment may be necessary for use in a radioactively-contaminated environment.

During excavation activities, all uncontaminated soils (i.e., soils meeting PRGs) would be stockpiled on site and replaced into the excavated area following removal of radionuclide-contaminated soil. Excavated soils would then be transported to the proposed ER INEEL soil repository for disposal, and treated tank contents would be transported to the RWMC for disposal. Verification sampling would be conducted to ensure that all contamination present at the subsites with concentrations exceeding PRGs was removed. The excavated areas would be backfilled with clean soils to natural grade and revegetated. Institutional controls would not be required after site excavation and disposal, since all contamination would be removed, and all exposure pathways would be eliminated.

At TSF-26, it is estimated that five distinct areas of radionuclide-contaminated soil exist. The radionuclide-contaminated soils above and surrounding the PM-2A V-13 and V-14 tanks, assumed to be approximately 18 × 12 m (60 × 40 ft) would be excavated to a depth of 9 m (30 ft). Radionuclide-contaminated soils within the other areas of TSF-26 to be removed would be excavated to a depth of 3 m (10 ft). Tanks V-13 and V-14 would be removed at TSF-26. The tanks are assumed to contain a total of 8,517 L (2,250 gal) of sludge and 379 L (100 gal) of liquid. Sludge volumes would increase by a factor of approximately two during treatment (stabilization).

12.6.2.1.1 Overall Protection of Human Health and the Environment—Under this alternative, human health and environmental risks and would be reduced at TSF-26. The removal of radionuclide-contaminated soil and tank contents would eliminate potential long-term human health and environmental concerns associated with direct exposure or contaminant migration from uncontrolled radioactive waste disposal sites. Therefore, Alternative 2a meets specified RAOs and provides for long-term protection of human health and the environment at TSF-26.

12.6.2.1.2 Compliance with ARARs and TBCs—Table 12-1 presents the evaluation of this alternative for compliance with the ARARs and TBCs. IDAPA 16.01.01650, 16.01.01161, and Air Toxics Rules apply to TSF-26 if they were a source of fugitive dust and are ARARs that would be met by performing excavation using water sprays and other techniques for dust suppression. 40 CFR 122.26, which regulates stormwater and associated discharges, would be met through engineering controls of surface water runoff. Hazardous waste rules would most likely apply to the treated tank contents and would be met through proper treatment and disposal methods. Tank waste and residues must be disposed of in accordance with the land disposal restrictions, 40 CFR 268. If the tank contents are determined to contain PCBs over 50 ppm, compliance with Toxic Substances Control Act (TSCA) regulations will also be required. DOE Orders would be met because health risks to current and future workers and potential residents would be within allowable ranges. This alternative would meet all ARARs and TBCs.

12.6.2.1.3 Long-Term Effectiveness and Permanence—This alternative provides for long-term and permanent prevention of human and environmental exposure to tank contents and radionuclide-contaminated soils at TSF-26. The long-term risk to human health and the environment is basically transferred from TSF-26 to the managed on-site disposal facilities. However, existing management practices at the disposal facilities would be continued to ensure minimal risks to human health and the environment. Because potential residential exposure to contaminants in soil and tank content TSF-26 is prevented, the long-term effectiveness and permanence of Alternative 2a is considered high.

12.6.2.1.4 ***Reduction of Toxicity, Mobility, or Volume Through Treatment***—Under this alternative no treatment is specified for radionuclide-contaminated soils. However, treatment of tank contents via stabilization is specified. Contaminated materials would be physically removed and contained at centrally-managed on-site disposal locations. Contaminant mobility, toxicity and volume would be eliminated at the individual OU 1-10 sites, although toxicity would not be affected at the disposal location as part of this alternative. Contaminant mobility would be minimized at the disposal location through effective waste management practices. Stabilization of tank contents prior to on-site disposal would likely result in additional reduction of contaminant mobility. However, the stabilization specified for tank contents would likely result in an increase in volume of contaminated media.

12.6.2.1.5 Short-Term Effectiveness—The exposure risk to workers during excavation and removal of contaminated soil and debris at TSF-26 could be significant, however radiation monitoring and control measures have been demonstrated to effectively mitigate risks in previous INEEL removal actions. Short-term effectiveness is therefore assessed as moderate. Equipment operator exposures would be minimized to the extent possible using established procedures. Supplied air and shielding in the form of leaded windows and lead lining on exterior facing surfaces of the equipment would be used as needed. Excavation equipment modified with positive-pressure ventilation system cabs and HEPA filters for use in radioactively-contaminated areas is available at the INEEL from previous remedial actions. If not available onsite, excavation equipment may be supplied by a subcontractor or may be purchased from vendors. However, modification of subcontractor or purchased equipment may be necessary for use in a radioactively-contaminated environment. The activities associated with removing these soils would require exposure to radioactive materials. The operator risk would be directly related to the time required to perform the excavation. Exposure and risk per operator could be decreased by increasing the number of equipment operators, and decreasing the time spent on site by any one person.

Nonexposure risks to workers are also a consideration during excavation. These risks result primarily from physical construction hazards, such as vehicle accidents or personnel injuries. However, implementation of appropriate health and safety measures for the excavation activities can minimize these risks.

Environmental impacts resulting from this alternative are dependent on the remedial design and required access areas. The surrounding landscape would likely be disturbed because of the equipment and vehicles moving in and around the site. However, the impact of these activities would be temporary, and the entire site would be restored to match the surrounding landscape at the completion of the project. No environmentally sensitive archaeological or historical sites, wetlands, or critical habitat exist at the OU 1-10 sites.

RAOs would be achieved by this alternative once excavation, treatment, and disposal at the on-site location is complete. Per DOE Order 5820.2A requirements during implementation of this alternative, exposures to equipment operators must be reduced below 25 mrem/yr.

12.6.2.1.6 Implementability—This alternative is technically feasible and has a moderate administrative feasibility. There are no site-specific conditions that exist at TSF-26 that would provide significant difficulty associated with soil and tank excavation, tank contents treatment, and transportation of soils and treated tank contents to the on-site disposal facility. Personnel, equipment and services associated with the soil and tank excavation portion of this alternative are readily available. Some specialized equipment associated with removal of the tank contents may be required. The implementation of this alternative would be moderately difficult because of the complexity of the retrieval system with respect to safety considerations and administrative constraints for on-site containment facility requirements. Significant effort would be required to perform environmental assessments, safety analysis, permit preparations, and equipment modifications (for operator safety), as well as system testing and demonstration.

12.6.2.1.7 Cost—The costs associated with Alternative 2a include excavation of radionuclide-contaminated soils and tanks at TSF-26, removal and treatment of tank contents, on-site disposal of soils at the proposed ER INEEL soil repository, disposal of treated tank contents at the RWMC, backfilling of excavated areas, and grading and revegetating the sites to natural conditions. The estimated NPV for each subsite is shown in Table 12-19. The alternative cost estimates are for comparison purposes only and not intended for budgetary, planning, or funding purposes.

12.6.2.2 Alternative 2b: Soil Excavation, Tank Removal, On-site Treatment, and Off-site Disposal. Alternative 2b would consist of excavation of the tanks and their contents, solidification of the dewatered tank contents, and transportation of the excavated soils and treated tank contents off-site at a commercial low-level radioactive waste disposal facility. The tanks and contaminated soils surrounding the tanks would be excavated using standard construction equipment. Tank contents would be removed remotely by jetting and pumping, or vacuum removal and the tanks would be decontaminated in-place prior to removal. Soils and tank wastes would be dewatered to extract liquids introduced during removal operations, and all wastes determined to have a classification greater then Class A, would be treated to create a stable waste form. The treated waste must conform to the U.S. NRC's Branch Technical Position on Waste Form which specifies limits on the leachability of contaminants and the structural stability of the material. Water generated during excavation and dewatering activities , if any, would be characterized and disposed of appropriately at the ICPP PEW System.

Conventional excavation and transportation equipment and procedures would be used under this alternative. Supplied air and shielding in the form of leaded windows and lead lining on exterior facing surfaces of the equipment would be used as needed. Excavation equipment modified with positive-pressure ventilation system cabs and HEPA filters for use in radioactively-contaminated areas is available at the INEEL from previous remedial actions. If not available onsite, excavation equipment may be supplied by a subcontractor or may be purchased from vendors. However, modification of subcontractor or purchased equipment may be necessary for use in a radioactively-contaminated environment.

During excavation activities, all uncontaminated soils would be stockpiled on site and replaced into the excavated area following removal of radionuclide-contaminates soil. Excavated soils and treated materials would be transported to a commercial disposal facility. Compliance with appropriate waste characterization and transportation requirements imposed by the facility would be required under this alternative. Verification sampling would be conducted to ensure that all contamination present at concentrations exceeding PRGs was removed. The excavated areas would be backfilled with clean soils after excavation and revegetated to natural conditions. Institutional controls would not be required after site excavation and disposal, since all contamination would be removed, and all exposure pathways would be eliminated.

At TSF-26, it is estimated that five distinct areas of radionuclide-contaminated soil exist. The radionuclide-contaminated soils above and surrounding the PM-2A V-13 and V-14 tanks, assumed to be approximately 18 × 12 m (60 × 40 ft), would be excavated to a depth of 9 m (30 ft). Radionuclide-contaminated soils within the other areas of TSF-26 to be removed would be excavated to a depth of 3 m (10 ft). Tanks V-13 and V-14 would be removed at TSF-26. The PM-2A tanks at TSF-26 are assumed to contain a total of 8,517 L (2,250 gal) of sludge and 379 L (100 gal) of liquid. Sludge volumes would increase by a factor of approximately two during treatment (stabilization).

12.6.2.2.1 Overall Protection of Human Health and the Environment— Under this alternative, human health and environmental risks and would be reduced at TSF-26. The removal of radionuclide-contaminated soil and tank contents would eliminate potential long-term human health and environmental concerns associated with direct exposure or contaminant migration from uncontrolled radioactive waste disposal sites. Therefore, Alternative 2b meets specified RAOs and provides for long-term protection of human health and the environment at TSF-26.

12.6.2.2.2 Compliance with ARARs and TBCs—Table 12-1 presents the evaluation of this alternative for compliance with the ARARs and TBCs. IDAPA 16.01.01650, 16.01.01161, and Air Toxics Rules apply to TSF-26 if they were a source of fugitive dust and are ARARs that would be met by performing excavation using water sprays and other techniques for dust suppression. 40 CFR 122.26, which regulates stormwater and associated discharges would be met through engineering controls of surface water runoff. Hazardous waste rules would most likely apply to the treated tank contents and

Table 12-19. Alternative 2a: NPV for TSF-26.

Site	NPV ($)
TSF-26 (PM-2A V-13 and V-14)	10,056,101

would be met through proper treatment and disposal methods. Tank waste and residues must be disposed of in accordance with the land disposal restrictions, 40 CFR 268. If the tank contents are determined to contain PCBs over 50 ppm, compliance with TSCA regulations will also be required. DOE Orders would be met because health risks to current and future workers and potential residents would be within allowable ranges. This alternative would meet all ARARs and TBCs.

12.6.2.2.3 Long-Term Effectiveness and Permanence—This alternative provides for long-term and permanent prevention of human and environmental exposure to tank contents and radionuclide-contaminated soils at TSF-26. The long-term risk to human health and the environment is basically transferred from TSF-26 to the managed off-site disposal facilities. However, existing management practices at the disposal facilities would be continued to ensure minimal risks to human health and the environment. Because potential residential exposure to contaminants in soil and tank contents at TSF-26 is prevented, the long-term effectiveness and permanence of Alternative 2b is considered high.

12.6.2.2.4 Reduction of Toxicity, Mobility, or Volume Through Treatment—Under this alternative no treatment is specified for radionuclide-contaminated soils. However, treatment of tank contents via solidification is specified. Contaminated materials would be physically removed and contained in a centrally-managed off-site disposal location. Contaminant mobility, toxicity, and volume would be eliminated at the individual OU 1-10 sites, although toxicity would not be affected at the off-site disposal location as part of this alternative. Contaminant mobility would be minimized at the disposal location through effective waste management practices. Solidification of tank contents prior to off-site disposal would likely result in additional reduction of contaminant mobility. However, solidification of tank contents may result in an increase in volume of contaminated media.

12.6.2.2.5 Short Term Effectiveness—The exposure risk to workers during excavation and removal of contaminated soil and tanks at TSF-26 could be significant, however radiation monitoring and control measures have been demonstrated to effectively mitigate risks in previous INEEL removal actions. Short-term effectiveness is therefore assessed as moderate. Equipment operator exposures would be minimized to the extent possible using established procedures. Supplied air and shielding in the form of leaded windows and lead lining on exterior facing surfaces of the equipment would be used as needed. Excavation equipment modified with positive-pressure ventilation system cabs and HEPA filters for use in radioactively-contaminated areas is available at the INEEL from previous remedial actions. If not available onsite, excavation equipment may be supplied by a subcontractor or may be purchased from vendors. However, modification of subcontractor or purchased equipment may be necessary for use in a radioactively-contaminated environment. The activities associated with removing these soils would require exposure to radioactive materials. The operator risk would be directly related to the time required to perform the excavation. Exposure and risk per operator could be decreased by increasing the number of equipment operators, and decreasing the time spent on site by any one person.

Nonexposure risks to workers are also a consideration during excavation. These risks result primarily from physical construction hazards, such as vehicle accidents or personnel injuries. However, implementation of appropriate health and safety measures for the excavation activities can minimize these risks.

Environmental impacts resulting from this alternative are dependent on the remedial design and required access areas. The surrounding landscape would likely be disturbed because of the equipment and vehicles moving in and around the site. However, the impact of these activities would be temporary, and the entire site would be restored to match the surrounding landscape at the completion of the project. No environmentally sensitive archaeological or historical sites, wetlands, or critical habitats exist at the OU 1-10 sites.

RAOs would be achieved by this alternative once excavation and disposal at the on-site location is complete. Per DOE Order 5820.2A requirements during implementation of this alternative, exposures to equipment operators must be reduced below 25 mrem/yr.

12.6.2.2.6 Implementability—This alternative is technically feasible and has a moderate administrative feasibility. There are no site-specific conditions that exist at TSF-26 that would provide significant difficulty associated with soil and tank excavation, tank contents treatment, and transportation of soils and treated materials off-site for disposal. Implementation of this alternative would be moderately difficult because of the complexity of the retrieval system with respect to safety considerations and on-site containment requirements. Significant effort would be required to perform environmental assessments, safety analyses, permit preparations, and equipment modifications (for operator safety), as well as system testing and demonstration. Off-site transportation of contaminated materials also presents potential administrative constraints due to potential exposures to human receptors between INEEL and the disposal facility. The identified off-site disposal facility is located approximately 480 km (300 mi) from the site. Coordination would be required between INEEL and disposal facility personnel to ensure disposal criteria are met before contaminated materials are excavated for off-site transport.

12.6.2.2.7 Cost—The cost associated with Alternative 2b would consist of excavation of the tanks and their contents, removal and treatment of tank contents, transportation of the excavated soils and treated tank contents off-site at a commercial low-level radioactive waste disposal facility, backfilling of excavated area, and grading and revegetating the site to natural conditions. The estimated NPV for each subsite is shown in Table 12-20. The alternative costs estimates are for comparison only and not intended for budgetary, planning, or funding purposes.

12.6.2.2.8 Alternative 2c: Soil Excavation, Tank Removal, and Off-Site Treatment and Disposal—Alternative 2c would consist of excavation of the tanks and their contents, and transportation of the excavated materials to an off-site facility for treatment and disposal. The tanks and contaminated soils surrounding the tanks would be excavated using standard construction equipment. Tank contents would be removed remotely by jetting and pumping, or vacuum removal and the tanks would be decontaminated in-place prior to removal. Soils and tank wastes would be dewatered to extract liquids introduced during removal operations, and the dewatered materials would be placed in high-integrity containers (HICs) and transported to a commercial low-level radioactive waste disposal facility for treatment and disposal. Water generated during excavation and dewatering activities, if any, would be characterized and disposed of appropriately at the ICPP PEW System.

Conventional excavation and transportation equipment and procedures would be used under this alternative. Supplied air and shielding in the form of leaded windows and lead lining on exterior facing surfaces of the equipment would be used as needed. Excavation equipment modified with positive-pressure

Table 12-20. Alternative 2b: NPV for TSF-26 soil excavation, tank removal, on-site treatment, off-site disposal.

Site	NPV ($)
TSF-26	12,762,394

ventilation system cabs and HEPA filters for use in radioactively-contaminated areas is available at the INEEL from previous remedial actions. If not available onsite, excavation equipment may be supplied by a subcontractor or may be purchased from vendors. However, modification of subcontractor or purchased equipment may be necessary for use in a radioactively-contaminated environment.

Compliance with appropriate waste characterization and transportation requirements imposed by the facility would be required under this alternative. During excavation activities, all uncontaminated soils would be stockpiled on site and replaced into the excavated area following removal of radionuclide-contaminated soil. Verification sampling would be conducted to ensure that all contamination present at concentrations exceeding PRGs was removed. The excavated areas would be backfilled with clean soils after excavation and revegetated to natural conditions. Institutional controls would not be required after site excavation and disposal, since all contamination would be removed, and all exposure pathways would be eliminated.

At TSF-26, it is estimated that five distinct areas of radionuclide-contaminated soil exist. The radionuclide-contaminated soils above and surrounding the PM-2A V-13 and V-14 tanks, estimated to be approximately 18 × 12 m (60 × 40 ft), would be excavated to a depth of 9 m (30 ft). Radionuclide-contaminated soils within the other areas of TSF-26 to be removed would be excavated to a depth of 3 m (10 ft). The PM-2A tanks at TSF-26 are assumed to contain a total of 8,517 L (2,250 gal) of sludge and 379 L (100 gal) of liquid. Sludge volumes would increase by a factor of approximately two during treatment (stabilization).

12.6.2.2.9 Overall Protection of Human Health and the Environment—Under this alternative, human health and environmental risks and would be reduced at TSF-26. The removal of radionuclide-contaminated soil and tank contents would eliminate potential long-term human health and environmental concerns associated with direct exposure or contaminant migration from uncontrolled radioactive waste disposal sites. Therefore, Alternative 2c meets specified RAOs and provides for long-term protection of human health and the environment at TSF-26.

12.6.2.2.10 Compliance with ARARs and TBCs—Table 12-1 presents the evaluation of this alternative for compliance with the ARARs and TBCs. IDAPA 16.01.01650, 16.01.01161, and Air Toxics Rules applies to TSF-26 if they were a source of fugitive dust and are ARARs that would be met by performing excavation using water sprays and other techniques for dust suppression. 40 CFR 122.26, which regulates stormwater and associated discharges would be met through engineering controls of surface water runoff. Hazardous waste rules would most likely apply to the treated tank contents and would be met through proper treatment and disposal methods. Tank waste and residues must be disposed of in accordance with the land disposal restrictions, 40 CFR 268. If the tank contents are determined to contain polychlorinated biphenyls (PCBs) over 50 ppm, compliance with TSCA regulations will also be required. DOE Orders would be met because health risks to current and future workers and potential residents would be within allowable ranges. This alternative would meet all ARARs and TBCs.

12.6.2.2.11 Long-Term Effectiveness and Permanence—This alternative provides for long-term and permanent prevention of human and environmental exposure to tank contents and radionuclide-contaminated soils at TSF-26. The long-term risk to human health and the environment is basically transferred from TSF-26 to the managed off-site disposal facility. However, existing management practices at the disposal facility would be continued to ensure minimal risks to human health and the environment. Because potential residential exposure to contaminants in soil and tank contents at TSF-26 is prevented, the long-term effectiveness and permanence of Alternative 2c is considered high.

12.6.2.2.12 Reduction of Toxicity, Mobility, or Volume Through Treatment— Under this alternative no treatment is specified for radionuclide-contaminated soils. However, off-site treatment of tank contents is specified. Contaminated materials would be physically removed and contained in a centrally-managed off-site disposal location. Contaminant mobility, toxicity, and volume would be eliminated at the individual OU 1-10 sites, although toxicity would likely not be affected at the off-site disposal location as part of this alternative. Contaminant mobility would be minimized at the disposal location through effective waste management practices. Off-site treatment of tank contents prior to disposal would likely result in additional reduction of contaminant mobility. However, treatment of the tank contents may result in an increase in volume of contaminated media.

12.6.2.2.13 Short-Term Effectiveness—The exposure risk to workers during excavation and removal of contaminated soil and tanks at TSF-26 could be significant, however radiation monitoring and control measures have been demonstrated to effectively mitigate risks in previous INEEL removal actions. Short-term effectiveness is therefore assessed as moderate. Equipment operator exposures would be minimized to the extent possible using established procedures. Supplied air and shielding in the form of leaded windows and lead lining on exterior facing surfaces of the equipment would be used as needed. Excavation equipment modified with positive-pressure ventilation system cabs and HEPA filters for use in radioactively-contaminated areas is available at the INEEL from previous remedial actions. If not available onsite, excavation equipment may be supplied by a subcontractor or may be purchased from vendors. However, modification of subcontractor or purchased equipment may be necessary for use in a radioactively-contaminated environment. The activities associated with removing these soils would require exposure to radioactive materials. The operator risk would be directly related to the time required to perform the excavation. Exposure and risk per operator could be decreased by increasing the number of equipment operators, and decreasing the time spent on site by any one person.

Nonexposure risks to workers are also a consideration during excavation. These risks result primarily from physical construction hazards, such as vehicle accidents or personnel injuries. However, implementation of appropriate health and safety measures for the excavation activities can minimize these risks.

Environmental impacts resulting from this alternative are dependent on the remedial design and required access areas. The surrounding landscape would likely be disturbed because of the equipment and vehicles moving in and around the site. However, the impact of these activities would be temporary, and the entire site would be restored to match the surrounding landscape at the completion of the project. No environmentally sensitive archaeological or historical sites, wetlands, or critical habitat exist at the OU 1-10 sites.

RAOs would be achieved by this alternative once excavation and disposal at the on-site location is complete. Per DOE Order 5820.2A requirements during implementation of this alternative, exposures to equipment operators must be reduced below 25 mrem/yr.

12.6.2.2.14 Implementability—This alternative is technically feasible and has a moderate administrative feasibility. There are no site-specific conditions that exist at TSF-26 that would provide significant difficulty associated with soil and tank excavation or transportation of soils and tank contents off-site for disposal. Implementation of this alternative would be moderately difficult because of the complexity of the retrieval system with respect to safety considerations and on-site containment requirements. Significant effort would be required to perform environmental assessments, safety analyses, permit preparations, and equipment modifications (for operator safety), as well as system testing and demonstration. Off-site transportation of untreated contaminated materials presents potential administrative constraints due to potential exposures to human receptors between INEEL and the disposal facility. The off-site disposal facility is located approximately 480 km (300 miles) from the site. Coordination would be required between INEEL and disposal facility personnel to ensure disposal criteria are met before contaminated materials are excavated for off-site transport.

12.6.2.2.16 Cost—The estimated costs associated with Alternative 2c were not calculated for inclusion in this FS.

12.6.3 Alternative 3: Soil Excavation, Tank Content Removal, Ex Situ Treatment, and Disposal

Alternative 3 is similar to Alternative 2; however, under Alternative 3 the tank contents would be removed while the tanks would be decontaminated and left in place. The following three alternatives were developed to address tank waste at TSF-26 (PM-2A V-13 and PM-2A V-14):

- Excavate contaminated soils, remove tank contents, decontaminate tanks in place, treat tank contents on-site, and dispose of the treated material at the RWMC and excavated soils at the proposed ER INEEL soil repository.

- Excavate contaminated soils, remove tank contents, decontaminate tanks in place, treat tank contents on-site, and dispose of the treated material and excavated soils off-site at a commercial low-level radioactive waste disposal facility.

The soil excavation, tank content removal, treatment, and disposal alternatives are discussed in the following subsections.

***12.6.3.1* Alternative 3a: Soil Excavation, Tank Content Removal, and On-site Treatment and Disposal.** Alternative 3a would consist of soil excavation, tank contents removal, tank decontamination, solidification of the dewatered tank contents, and disposal of the excavated soils on-site at the proposed ER INEEL soil repository and treated contents at RWMC. Contaminated soils surrounding the tanks would be excavated using standard construction equipment. Tank contents would be removed remotely utilizing technologies such as jetting and pumping or removal by vacuum. Soils and tank wastes would be dewatered to extract liquids introduced during removal operations, and all wastes determined to have a classification greater then Class A, would be treated to create a stable waste form. The treated waste must conform to the U.S. NRC's Branch Technical Position on Waste Form which specifies limits on the leachability of contaminants and the structural stability of the material. Excavated materials requiring treatment would be solidified on-site by mixing with chemical additives such as phosphates or silicates. Water generated during excavation would be characterized and disposed of appropriately. The tanks would be decontaminated and filled with an inert material such as sand or cement.

Conventional excavation and transportation equipment and procedures would be used under this alternative. Supplied air and shielding in the form of leaded windows and lead lining on exterior facing surfaces of the equipment would be used as needed. Excavation equipment modified with positive-pressure ventilation system cabs and HEPA filters for use in radioactively-contaminated areas is available at the INEEL from previous remedial actions. If not available onsite, excavation equipment may be supplied by a subcontractor or may be purchased from vendors. However, modification of subcontractor or purchased equipment may be necessary for use in a radioactively-contaminated environment.

Excavated soils would be transported to the proposed ER INEEL soil repository for disposal. Treated tank contents would be transported to the RWMC for disposal. During excavation activities, all uncontaminated soils would be stockpiled on site and replaced into the excavated area following removal of radionuclide-contaminated soil. Verification sampling would be conducted to ensure that all contamination present at concentrations exceeding PRGs was removed. The excavated areas would be backfilled with clean soils after excavation and revegetated to natural conditions. Institutional controls would not be required after site excavation and disposal, since all contamination would be removed, and all exposure pathways would be eliminated.

At TSF-26, it is estimated that five distinct areas of radionuclide-contaminated soil exist. The radionuclide-contaminated soils above and surrounding the PM-2A V-13 and V-14 tanks, estimated to be approximately 18 × 12 m (60 × 40 ft), would be excavated to a depth of 3 m (10 ft). Radionuclide-contaminated soils within the other areas of TSF-26 to be removed would also be excavated to a depth of 3 m (10 ft). The contents of Tanks V-13 and V-14 would be removed, however, the tanks themselves would remain in place. The PM-2A tanks at TSF-26 are assumed to contain a total of 8,517 L (2,250 gal) of sludge and 379 L (100 gal) of liquid. Sludge volumes would increase by a factor of approximately two during treatment (stabilization).

12.6.3.1.1 Overall Protection of Human Health and the Environment—Under this alternative, human health and environmental risks and would be reduced at TSF-26. The removal of radionuclide-contaminated soil and tank contents would eliminate potential long-term human health and environmental concerns associated with direct exposure or contaminant migration from uncontrolled radioactive waste disposal sites. Therefore, Alternative 3a meets specified RAOs and provides for long-term protection of human health and the environment at TSF-26.

12.6.3.1.2 Compliance with ARARs and TBCs—Table 12-1 presents the evaluation of this alternative for compliance with the ARARs and TBCs. IDAPA 16.01.01650, 16.01.01161, and Air Toxics Rules applies TSF-26 if they were a source of fugitive dust and are ARARs that would be met by performing excavation using water sprays and other techniques for dust suppression. 40-CFR 122.26, which regulates stormwater and associated discharges would be met through engineering controls of surface water runoff.

Hazardous waste rules would most likely apply to the treated tank contents and would be met through proper treatment and disposal methods. Tank waste and residues must be disposed of in accordance with the land disposal restrictions, 40 CFR 268. If the tank contents are determined to contain PCBs over 50 ppm, compliance with TSCA regulations will also be required. This alternative would meet all ARARs and TBCs through proper waste management techniques. DOE Orders would be met because health risks to current and future workers and potential residents would be within allowable ranges.

12.6.3.1.3 Long-Term Effectiveness and Permanence—This alternative provides for long-term and permanent prevention of human and environmental exposure to tank contents and radionuclide-contaminated soils at TSF-26. The long-term risk to human health and the environment is basically transferred from TSF-26 to the managed on-site disposal facilities. However, existing management practices at the disposal facilities would be continued to ensure minimal risks to human health and the environment. Because potential residential exposure to contaminants in soil and tank contents at TSF-26 is prevented, the long-term effectiveness and permanence of Alternative 3a is considered high.

12.6.3.1.4 Reduction of Toxicity, Mobility, or Volume Through Treatment—Under this alternative no treatment is specified for radionuclide-contaminated soils. However, treatment of tank contents via stabilization is specified. Contaminated materials would be physically removed and contained in a centrally-managed on-site disposal location. Contaminant mobility, toxicity and volume would be eliminated at the individual OU 1-10 sites, although toxicity would not be affected at the disposal location as part of this alternative. Stabilization of tank contents prior to on-site disposal would likely result in a reduction of contaminant mobility within these materials. In addition, contaminant mobility would be minimized at the disposal location through effective waste management practices. The stabilization specified for tank contents may result in an increase in volume of contaminated media.

12.6.3.1.5 Short-Term Effectiveness—The exposure risk to workers during excavation and removal of tank contents and contaminated soil at TSF-26 could be significant, however radiation monitoring and control measures have been demonstrated to effectively mitigate risks in previous INEEL removal actions. Short-term effectiveness is therefore assessed as moderate. Equipment operator exposures would be minimized to the extent possible using established procedures. Supplied air and shielding in the form of leaded windows and lead lining on exterior facing surfaces of the equipment would be used as needed. Excavation equipment modified with positive-pressure ventilation system cabs and HEPA filters for use in radioactively-contaminated areas is available at the INEEL from previous remedial actions. If not available onsite, excavation equipment may be supplied by a subcontractor or may be purchased from vendors. However, modification of subcontractor or purchased equipment may be necessary for use in a radioactively-contaminated environment. The activities associated with removing these soils would require exposure to radioactive materials. The operator risk would be directly related to the time required to perform the excavation. Exposure and risk per operator could be decreased by increasing the number of equipment operators, and decreasing the time spent on site by any one person.

Nonexposure risks to workers are also a consideration during excavation. These risks result primarily from physical construction hazards, such as vehicle accidents or personnel injuries. However, implementation of appropriate health and safety measures for the excavation activities can minimize these risks.

Environmental impacts resulting from this alternative are dependent on the remedial design and required access areas. The surrounding landscape would likely be disturbed because of the equipment and vehicles moving in and around the site. However, the impact of these activities would be temporary, and the entire site would be restored to match the surrounding landscape at the completion of the project. No environmentally sensitive archaeological or historical sites, wetlands, or critical habitat exist at the OU 1-10 sites.

RAOs would be achieved by this alternative once excavation and disposal at the on-site location is complete. Per DOE Order 5820.2A requirements during implementation of this alternative, exposures to equipment operators must be reduced below 25 mrem/yr.

12.6.3.1.6 Implementability—This alternative has a moderate technical and administrative feasibility. There are no site-specific conditions that exist at TSF-26 that would provide significant difficulty associated with soil excavation, tank contents removal and treatment, and transpiration of soils and treated tank contents to the on-site disposal facility. Personnel, equipment and services associated with the soil and tank excavation portion of this alternative are readily available, although specialized equipment associated with in-place removal of the tank contents may be required. Implementation of this alternative would be moderately difficult because of the complexity of the retrieval system with respect to safety considerations and on-site containment requirements. Significant effort would be required to perform environmental assessments, safety analyses, permit preparations, and equipment modifications (for operator safety), as well as system testing and demonstration.

12.6.3.1.7 Cost—The costs associated with Alternative 3a include excavation of radionuclide-contaminated soils and tanks at TSF-26, removal and treatment of tank contents, tank decontamination and on-site disposal of soils and treated tank contents at the proposed ER INEEL soil repository and RWMC, respectively. Estimated total project costs are shown in Table 12-21. The alternative cost estimates are for comparison purposes only and not intended for budgetary, planning, or funding purposes.

12.6.3.2 Alternative 3b: Soil Excavation, Tank Content Removal, On-site Treatment, and Off-site Disposal. Alternative 3b would consist of excavation of tank contents, decontamination of tanks in-place, solidification of the dewatered tank contents, and transportation of the excavated soils and treated materials off-site at a commercial low-level radioactive waste disposal facility. Contaminated soils surrounding the tanks would be excavated using standard construction equipment. Tank contents would be removed remotely using technologies such as jetting and pumping or removal by vacuum. Soils and tank wastes would be dewatered to extract liquids introduced during removal operations, and all wastes determined to have a classification greater then Class A, would be treated to create a stable waste form. The treated waste must conform to the U.S. Nuclear Regulatory Commission's Branch Technical Position on Waste Form which specifies limits on the leachability of contaminants and the structural stability of the material. Excavated materials requiring treatment would be solidified on-site by mixing with chemical additives such as phosphates or silicates. Water generated during excavation would be characterized and disposed of appropriately at the ICPP PEW System. The tanks would be decontaminated in place and filled with an inert material such as sand or cement.

Conventional excavation and transportation equipment and procedures would be used under this alternative. Supplied air and shielding in the form of leaded windows and lead lining on exterior facing surfaces of the equipment would be used as needed. Excavation equipment modified with positive-pressure ventilation system cabs and HEPA filters for use in radioactively-contaminated areas is available at the INEEL from previous remedial actions. If not available onsite, excavation equipment may be supplied by a subcontractor or may be purchased from vendors. However, modification of subcontractor or purchased equipment may be necessary for use in a radioactively-contaminated environment.

Excavated soils and treated materials would be transported to a commercial disposal facility. Compliance with appropriate waste characterization and transportation requirements imposed by the off-site disposal facility would be required under this alternative. During excavation activities, all uncontaminated soils would be stockpiled on site and replaced into the excavated area following removal of radionuclide-contaminated soil. Verification sampling would be conducted to ensure that all contamination present at concentrations exceeding PRGs was removed. The excavated areas would be backfilled with clean soils after excavation and revegetated to natural conditions. Institutional controls would not be required after site excavation and disposal, since all contamination would be removed, and all exposure pathways would be eliminated.

Table 12-21. Alternative 3a: NPV for TSF-26.

Site	NPV ($)
TSF-26 (PM-2A V-13 and V-14)	9,124,666

At TSF-26, it is estimated that five distinct areas of radionuclide-contaminated soil exist. The radionuclide-contaminated soils above and surrounding the PM-2A V-13 and V-14 tanks, estimated to be approximately 18 × 12 m (60 × 40 ft), would be excavated to a depth of 3 m (10 ft). Radionuclide-contaminated soils within the other areas of TSF-26 to be removed would also be excavated to a depth of 3m (10 ft). The contents of Tanks V-13 and V-14 would be removed however, the tanks themselves would remain in place. The PM-2A tanks at TSF-26 are assumed to contain a total of 8,517 L (2,250 gal) of sludge and 379 L (100 gal) of liquid. Sludge volumes would increase by a factor of approximately two during treatment (stabilization).

12.6.3.2.1 Overall Protection of Human Health and the Environment—Under this alternative, human health and environmental risks would be reduced at TSF-26. The removal of radionuclide-contaminated soil and tank contents would eliminate potential long-term human health and environmental concerns associated with direct exposure or contaminant migration from uncontrolled radioactive waste disposal sites. Therefore, Alternative 3b meets specified RAOs and provides for long-term protection of human health and the environment at TSF-26.

12.6.3.2.2 Compliance with ARARs and TBCs—Table 12-1 presents the evaluation of this alternative for compliance with the ARARs and TBCs. IDAPA 16.01.01650, 16.01.01161, and Air Toxics Rules applies to TSF-26 if they were a source of fugitive dust and are ARARs that would be met by performing excavation using water sprays and other techniques for dust suppression. 40 CFR 122.26, which regulates stormwater and associated discharges would be met through engineering controls of surface water runoff. Hazardous waste rules would most likely apply to the treated tank contents and would be met through proper treatment and disposal methods. Tank waste and residues must be disposed of in accordance with the land disposal restrictions, 40 CFR 268. If the tank contents are determined to contain PCBs over 50 ppm, compliance with TSCA regulations will also be required. This alternative would meet all ARARs and TBCs through proper waste management techniques. DOE Orders would be met because health risks to current and future workers and potential residents would be within allowable ranges.

12.6.3.2.3 Long-Term Effectiveness and Permanence—This alternative provides for long-term and permanent prevention of human and environmental exposure to tank contents and radionuclide-contaminated soils at TSF-26. The long-term risk to human health and the environment is basically transferred from TSF-26 to the managed off-site disposal facility. However, existing management practices at the disposal facility would be continued to ensure minimal risks to human health and the environment. Because potential residential exposure to contaminants in soil and tank contents at TSF-26 is prevented, the long-term effectiveness and permanence of Alternative 3b is considered high.

12.6.3.2.4 Reduction of Toxicity, Mobility, or Volume Through Treatment—Under this alternative no treatment is specified for radionuclide-contaminated soils. However, treatment of tank contents via solidification is specified. Contaminated materials would be physically removed and contained in a centrally-managed off-site disposal location. Contaminant mobility, toxicity, and volume would be eliminated at the individual OU 1-10 sites, although toxicity would not be affected at the off-site disposal location as part of this alternative. Solidification of tank contents prior to off-site disposal would likely result in a reduction of contaminant mobility within these materials. In addition, contaminant mobility would be minimized at the disposal location through effective waste management practices. Solidification of tank contents may result in an increase in volume of contaminated media to be disposed.

12.6.3.2.5 Short-Term Effectiveness—The exposure risk to workers during excavation and removal of tank contents and contaminated soil and tanks at TSF-26 could be significant, however radiation monitoring and control measures have been demonstrated to effectively mitigate risks in previous INEEL removal actions. Short-term effectiveness is therefore assessed as moderate. Equipment operator exposures would be minimized to the extent possible using established procedures. Supplied air and shielding in the form of leaded windows and lead lining on exterior facing surfaces of the equipment would be used as needed. Excavation equipment modified with positive-pressure ventilation system cabs and HEPA filters for use in radioactively-contaminated areas is available at the INEEL from previous remedial actions. If not available onsite, excavation equipment may be supplied by a subcontractor or may be purchased from vendors. However, modification of subcontractor or purchased equipment may be necessary for use in a radioactively-contaminated environment. The activities associated with removing these soils would require exposure to radioactive materials. The operator risk would be directly related to the time required to perform the excavation. Exposure and risk per operator could be decreased by increasing the number of equipment operators, and decreasing the time spent on site by any one person.

Nonexposure risks to workers are also a consideration during excavation. These risks result primarily from physical construction hazards, such as vehicle accidents or personnel injuries. However, implementation of appropriate health and safety measures for the excavation activities can minimize these risks.

Environmental impacts resulting from this alternative are dependent on the remedial design and required access areas. The surrounding landscape would likely be disturbed because of the equipment and vehicles moving in and around the site. However, the impact of these activities would be temporary, and the entire site would be restored to match the surrounding landscape at the completion of the project. No environmentally sensitive archaeological or historical sites, wetlands, or critical habitat exist at the OU 1-10 sites.

RAOs would be achieved by this alternative once excavation and disposal at the on-site location is complete. Per DOE Order 5820.2A requirements during implementation of this alternative, exposures to equipment operators must be reduced below 25 mrem/yr.

12.6.3.2.6 Implementability—This alternative has a moderate technical feasibility and is administratively feasible. There are no site-specific conditions that exist at TSF-26 that would provide significant difficulty associated with soil excavation, tank contents treatment, and transportation of soils and treated tank contents to an off-site disposal facility. Personnel and services associated with the soil and tank excavation portion of this alternative are readily available, although specialized equipment associated with in-place removal of the tank contents may be required. Implementation of this alternative would be moderately difficult because of the complexity of the retrieval system with respect to safety considerations and on-site containment requirements. Significant effort would be required to perform environmental assessments, safety analyses, permit preparations, and equipment modifications (for operator safety), as well as system testing and demonstration. Off-site transportation of contaminated materials presents potential administrative constraints due to potential exposures to human receptors between INEEL and the disposal facility. Coordination would be required between INEEL and disposal facility personnel to ensure disposal criteria are met before contaminated materials are excavated for off-site transport.

12.6.3.2.7 Cost—The costs associated with Alternative 3b include excavation of radionuclide contaminated soils and tank contents at TSF-26, decontamination of tanks in-place, solidification of the dewatered tank contents, and transportation of the excavated soils and treated materials off-site to a commercial low-level radioactive waste disposal facility. Estimated costs are shown on Table 12-22. The alternative cost estimates are for comparison purposes only and not intended for budgetary, planning, or funding purposes.

12.6.4 Alternative 4: Soil Excavation, In Situ Treatment of Tank Contents, and Soil Disposal

The following alternatives were developed to address tank waste at TSF-26 (PM2A V-13 and PM2A V-14):

- Excavate contaminated soils, grout tank contents in-place, and dispose of the excavated soils at the proposed ER INEEL soil repository.

- Excavate contaminated soils, grout tank contents in-place, and dispose of the excavated soils off-site at a commercial low-level radioactive waste disposal facility.

The soil excavation, in-situ treatment of tank contents, and soil disposal alternatives are discussed in the following subsections.

12.6.4.1 Alternative 4a: Soil Excavation, In-situ Treatment of Tank Contents, and On-site Soil Disposal. Alternative 4a would consist of grouting tank contents in-place, and disposal of the excavated soils on-site at the proposed ER INEEL soil repository. Contaminated soils surrounding the tanks would be excavated using standard construction equipment. Tank contents would be grouted in place remotely by mixing the tank contents and injecting grout into the tanks through existing sample ports. Excavated soils would be transported to the proposed soil repository for disposal. During excavation activities, all uncontaminated soils would be stockpiled on site and replaced into the excavated area following removal of radionuclide-contaminated soil. Verification sampling would be conducted to ensure that all contamination present at concentrations exceeding PRGs was removed. The excavated areas would be backfilled with clean soils after excavation and revegetated to natural conditions. Environmental monitoring to confirm no contaminant migration from the tank area would be conducted following completion of the remedial action. This monitoring may consist of the placement of boreholes and/or monitoring wells through the treated waste form to the underlying soils. In addition, five-year site reviews would be conducted to evaluate the effectiveness of the institutional controls and the need for further environmental monitoring, or additional control measures as applicable. Five-year site reviews would be conducted for a 100 year period. Implementation of this alternative likely prevents return of this site to unrestricted use; however treated tank contents will be at depths greater than 10 feet.

Conventional excavation and transportation equipment and procedures would be used under this alternative. Supplied air and shielding in the form of leaded windows and lead lining on exterior facing surfaces of the equipment would be used as needed. Excavation equipment modified with positive-pressure ventilation system cabs and HEPA filters for use in radioactively-contaminated areas is available at the INEEL from previous remedial actions. If not available onsite, excavation equipment may be supplied by a subcontractor or may be purchased from vendors. However, modification of subcontractor or purchased equipment may be necessary for use in a radioactively-contaminated environment.

Table 12-22. Alternative 3b: NPV for TSF-26.

Site	NPV($)
TSF-26 (PM-2A V-13, and V-14)	12,074,943

At TSF-26, it is estimated that five distinct areas of radionuclide-contaminated soil exist. The radionuclide-contaminated soils above and surrounding the PM-2A V-13 and V-14 tanks, estimated to be approximately 18 × 12 m (60 × 40 ft), would be excavated to a depth of 3 m (10 ft). Radionuclide-contaminated soils within the other areas of TSF-26 to be removed would also be excavated to a depth of 3 m (10 ft). The contents of Tanks V-13 and V-14 would be solidified in place by mixing the tank contents and injecting grout into existing openings in the tanks. An off gas collection system would be established to collect the vapors that would escape from the tanks during the grouting process.

12.6.4.1.1 Overall Protection of Human Health and the Environment—Under this alternative, human health and environmental risks and would be reduced by preventing direct exposure to tank contents and radionuclides in soils at TSF-26. Removal of radionuclide-contaminated soil and in-place treatment of tank contents would provide long-term protection from direct exposure and contaminant migration. Therefore, this alternative meets specified RAOs and provides for overall protection of human health and the environment at TSF-26.

12.6.4.1.2 Compliance with ARARs and TBCs—Table 12-1 presents the evaluation of this alternative for compliance with the ARARs and TBCs. IDAPA 16.01.01650, 16.01.01161, and Air Toxics Rules applies to TSF-26 if they were a source of fugitive dust and are ARARs that would be met by performing excavation using water sprays and other techniques for dust suppression. 40 CFR 122.26, which regulates stormwater and associated discharges would be met through engineering controls of surface water runoff. Hazardous waste rules would most likely apply to the treated tank contents and would be met through proper treatment and disposal methods. In addition, the waste and residues must be disposed of in accordance with the land disposal restrictions, 40 CFR 268. If the tank contents are determined to contain PCBs over 50 ppm, compliance with TSCA regulations will also be required. This alternative would meet all ARARs and TBCs through proper waste management techniques. DOE Orders would be met because health risks to current and future workers and potential residents would be within allowable ranges.

12.6.4.1.3 Long-Term Effectiveness and Permanence—This alternative provides for long-term and permanent prevention of human and environmental exposure to tank contents and radionuclide-contaminated soils at TSF-26. The long-term risk to human health and the environment from radionuclide-contaminated soils is basically transferred from TSF-26 to the managed off-site disposal facility. However, existing management practices at the disposal facilities would be continued to ensure minimal risks to human health and the environment. Because potential residential exposure to contaminants in soil and tank contents at TSF-26 is prevented, the long-term effectiveness and permanence of Alternative 4a is considered high.

12.6.4.1.4 Reduction of Toxicity, Mobility, or Volume Through Treatment—Under this alternative no treatment is specified for radionuclide-contaminated soils. However, in situ treatment of tank contents in place via solidification is specified. Solidification of tank contents in place would likely result in a reduction of contaminant mobility. However, solidification may result in an increase in volume of contaminated media. The toxicity of the treated tank contents is likely to be relatively unaffected by solidification. Contaminant mobility of radionuclide-contaminated soils would be minimized at the on-site disposal facility through the continuation of existing management practices.

12.6.4.1.5 Short-Term Effectiveness—The exposure risk to workers during soil excavation solidification of tank contents at TSF-26 could be significant, however radiation monitoring and control measures have been demonstrated to effectively mitigate risks in previous INEEL removal actions. Short-term effectiveness is therefore assessed as moderate. Equipment operator exposures would be minimized to the extent possible using established procedures. Supplied air and shielding in the form of leaded windows and lead lining on exterior facing surfaces of the equipment would be used as needed. Excavation equipment modified with positive-pressure ventilation system cabs and HEPA filters for use in radioactively-contaminated areas is available at the INEEL from previous remedial actions. If not available onsite, excavation equipment may be supplied by a subcontractor or may be purchased from vendors. However, modification of subcontractor or purchased equipment may be necessary for use in a radioactively-contaminated environment. The activities associated with removing these soils would require exposure to radioactive materials. The operator risk would be directly related to the time required to perform the excavation. Exposure and risk per operator could be decreased by increasing the number of equipment operators, and decreasing the time spent on site by any one person.

Nonexposure risks to workers are also a consideration during excavation. These risks result primarily from physical construction hazards, such as vehicle accidents or personnel injuries. However, implementation of appropriate health and safety measures for the excavation activities can minimize these risks.

Environmental impacts resulting from this alternative are dependent on the remedial design and required access areas. The surrounding landscape would likely be disturbed because of the equipment and vehicles moving in and around the site. However, the impact of these activities would be temporary, and the entire site would be restored to match the surrounding landscape at the completion of the project. No environmentally sensitive archaeological or historical sites, wetlands, or critical habitat exist at the OU 1-10 sites.

RAOs would be achieved by this alternative once excavation and disposal at the on-site location is complete. Per DOE Order 5820.2A requirements during implementation of this alternative, exposures to equipment operators must be reduced below 25 mrem/yr.

***12.6.4.1.6* Implementability**—This alternative is technically feasible and has a moderate administrative feasibility. There are no site-specific conditions that exist at TSF-26 that would provide significant difficulty associated with soil excavation or transportation of soils to the proposed ER INEEL soil repository for disposal. Personnel, equipment and services associated with the soil excavation and grout injection of tanks are readily available. Long-term monitoring of the site would be required to verify the effectiveness of the in-place treatment of the tank contents. Implementation of this alternative would be moderately difficult because of the complexity of the retrieval system with respect to safety consideration and on-site containment requirements. Significant effort would be required to perform environmental assessments, safety analyses, permit preparation, and equipment modifications.

12.6.4.1.7 Cost—The costs associated with Alternative 4a include excavation of radionuclide-contaminated soils at TSF-26, in-place solidification of tank contents, and on-site transport and disposal of soils at the proposed ER INEEL soil repository. The estimated NPV for Alternative 4a is shown in Table 12-23. The alternative cost estimates are for comparison purposes only and not intended for budgetary, planning, or funding purposes.

12.6.4.2 Alternative 4b: Soil Excavation, In Situ Treatment of Tank Contents, and Off-site Soil Disposal. Alternative 4b would consist of soil excavation, grouting tank contents in-place, and transportation of the excavated soils off-site to a commercial low-level radioactive waste disposal facility. Contaminated soils surrounding the tanks would be excavated using standard construction equipment. Tank contents would be grouted in place by mixing the tank contents and injecting grout into the tanks through existing sample ports. During excavation activities, all uncontaminated soils would be stockpiled on site and replaced into the excavated area following removal of radionuclide-contaminated soil. Excavated soils would be transported to a commercial low-level radioactive waste disposal facility. Compliance with appropriate waste characterization and transportation requirements imposed by the facility would be required under this alternative. Verification sampling would be conducted to ensure that all contamination present at concentrations exceeding PRGs was removed. The excavated areas would be backfilled with clean soils after excavation and revegetated to natural conditions. Environmental monitoring to confirm no contaminant migration from the tank area would be conducted following completion of the remedial action. This monitoring may consist of the placement of boreholes and/or monitoring wells through the treated waste form to the underlying soils. In addition, five-year site reviews would be conducted to evaluate the effectiveness of the institutional controls and the need for further environmental monitoring, or additional control measures as applicable. Five-year site reviews would be conducted for a 100-year period. Implementation of this alternative likely prevents return of this site to unrestricted use; however treated tank contents will be at depths greater than 10 feet.

Conventional excavation and transportation equipment and procedures would be used under this alternative. Supplied air and shielding in the form of leaded windows and lead lining on exterior facing surfaces of the equipment would be used as needed. Excavation equipment modified with positive-pressure ventilation system cabs and HEPA filters for use in radioactively-contaminated areas is available at the INEEL from previous remedial actions. If not available onsite, excavation equipment may be supplied by a subcontractor or may be purchased from vendors. However, modification of subcontractor or purchased equipment may be necessary for use in a radioactively-contaminated environment.

At TSF-26, it is estimated that five distinct areas of radionuclide-contaminated soil exist. The radionuclide-contaminated soils above and surrounding the PM-2A V-13 and V-14 tanks, estimated to be approximately 18 × 12 m (60 × 40 ft), would be excavated to a depth of 3 m (10 ft). Radionuclide-contaminated soils within the other areas of TSF-26 to be removed would also be excavated to a depth of 3 m (10 ft). The contents of Tanks V-13 and V-14 would be solidified in place by mixing the tank contents and injecting grout into existing openings in the tanks. An off gas collection system would be established to collect the vapors that would escape from the tanks during the grouting process.

12.6.4.2.1 Overall Protection of Human Health and the Environment—Under this alternative, human health and environmental risks and would be reduced by preventing direct exposure to tank contents and radionuclides in soils at TSF-26. Removal of radionuclide-contaminated soil and in-place treatment of tank contents would provide long-term protection form direct exposure and contaminant migration. Therefore, this alternative meets specified RAOs and provides for overall protection of human health and the environment at TSF-26.

12.6.4.2.2 Compliance with ARARs and TBCs—Table 12-1 presents the evaluation of this alternative for compliance with the ARARs and TBCs. IDAPA 16.01.01650, 16.01.01161, and Air Toxics Rules applies to TSF-26 if it was a source of fugitive dust and are ARARs that would be met by performing excavation using water sprays and other techniques for dust suppression. 40 CFR 122.26, which regulates stormwater and associated discharges would be met through engineering controls of surface water runoff. Hazardous waste rules would most likely apply to the treated tank contents and

Table 12-23. Alternative 4a: NPV for TSF-26.

Site	NPV ($)
TSF-26 (PM-2A V-13 and V-14)	6,100,749

would be met through proper treatment methods. In addition, soils and residues must be disposed of in accordance with the land disposal restrictions, 40 CFR 268. If the tank contents are determined to contain PCBs over 50 ppm, compliance with TSCA regulations will also be required. This alternative would meet all ARARs and TBCs through proper waste management techniques. DOE Orders would be met because health risks to current and future workers and potential residents would be within allowable ranges.

12.6.4.2.3 Long-Term Effectiveness and Permanence—This alternative provides for long-term and permanent prevention of human and environmental exposure to tank contents and radionuclide-contaminated soils at TSF-26. The long-term risk to human health and the environment is basically transferred from TSF-26 to the managed off-site disposal facilities. However, existing management practices at the disposal facilities would be continued to ensure minimal risks to human health and the environment. Because potential residential exposure to contaminants in soil and tank contents at and TSF-26 (PM-2A V-13 and PM-2A V-14) is prevented, the long-term effectiveness and permanence of Alternative 4b is considered high.

12.6.4.2.4 Reduction of Toxicity, Mobility, or Volume Through Treatment—Under this alternative no treatment is specified for radionuclide-contaminated soils. However, in situ treatment of tank contents in place via solidification is specified. Solidification of tank contents in place would likely result in a reduction of contaminant mobility. However, the solidification specified for tank contents would likely result in an increase in volume of contaminated media. The toxicity of the treated tank contents is likely to be relatively unaffected by solidification. Contaminant toxicity, mobility, and volume of the excavated soils would be eliminated from TSF-26. However, contaminant toxicity, mobility, and volume would basically be transferred to the off-site disposal location. Contaminant mobility of radionuclide-contaminated soils would be minimized at the off-site disposal location through effective waste management practices.

12.6.4.2.5 Short-Term Effectiveness—The exposure risk to workers during excavation and removal of contaminated soil and in situ treatment of tank contents at TSF-26 could be significant, however radiation monitoring and control measures have been demonstrated to effectively mitigate risks in previous INEEL removal actions. Short-term effectiveness is therefore assessed as moderate. Equipment operator exposures would be minimized to the extent possible using established procedures. Supplied air and shielding in the form of leaded windows and lead lining on exterior facing surfaces of the equipment would be used as needed. Excavation equipment modified with positive-pressure ventilation system cabs and HEPA filters for use in radioactively-contaminated areas is available at the INEEL from previous remedial actions. If not available onsite, excavation equipment may be supplied by a subcontractor or may be purchased from vendors. However, modification of subcontractor or purchased equipment may be necessary for use in a radioactively-contaminated environment. The activities associated with removing these soils would require exposure to radioactive materials. The operator risk would be directly related to the time required to perform the excavation. Exposure and risk per operator could be decreased by increasing the number of equipment operators, and decreasing the time spent on site by any one person.

Nonexposure risks to workers are also a consideration during excavation. These risks result primarily from physical construction hazards, such as vehicle accidents or personnel injuries. However, implementation of appropriate health and safety measures for the excavation activities can minimize these risks.

Environmental impacts resulting from this alternative are dependent on the remedial design and required access areas. The surrounding landscape would likely be disturbed because of the equipment and vehicles moving in and around the site. However, the impact of these activities would be temporary, and the entire site would be restored to match the surrounding landscape at the completion of the project. No environmentally sensitive archaeological or historical sites, wetlands, or critical habitat exist at the OU 1-10 sites.

RAOs would be achieved by this alternative once excavation and disposal at the off-site location is complete. Per DOE Order 5820.2A requirements during implementation of this alternative, exposures to equipment operators must be reduced below 25 mrem/yr.

12.6.4.2.6 Implementability— This alternative is technically feasible and has a moderate administrative feasibility. There are no site-specific conditions that exist at TSF-26 that would provide significant difficulty associated with in situ treatment of tank contents, soil excavation, or transportation of soils to the off-site disposal facility. Personnel, equipment, and services associated with the soil excavation and grout injection of tanks are readily available. Long-term monitoring of the site would be required to verify the effectiveness of the in-place treatment of the tank contents. Implementation of this alternative would be moderately difficult because of the complexity of the retrieval system with respect to safety consideration and off-site containment requirements. Significant effort would be required to perform environmental assessments, safety analyses, permit preparation, and equipment modifications (for operator safety), as well as system testing and demonstration. Off-site transportation of contaminated materials presents potential administrative constraints due to potential exposures to human receptors between INEEL and the disposal facility. Coordination would be required between INEEL and disposal facility personnel to ensure disposal criteria are met before contaminated materials are excavated for off-site transport.

12.6.4.2.7 Cost—The cost associated with Alternative 4b include excavation of radionuclide soils at TSF-26, in-place solidification of tank contents, and off-site transport and disposal of soils to a commercial low-level radioactive waste disposal facility. The estimated NPV for Alternative 4b is shown in Table 12-24. The alternative cost estimated are for comparison purposes only and not intended for budgetary, planning, or funding purposes.

12.6.5 Alternative 5: Soil Excavation, In Situ Vitrification of Tank Contents and Soils Within the Treatment Area, and Soil Disposal.

The following alternatives were developed to address contaminated soils and tank waste at TSF-26 (PM2A V-13 and V-14):

- Excavate contaminated soils, vitrify tank contents in-place, and dispose of the excavated soils at the proposed ER INEEL soil repository.

- Excavate contaminated soils, vitrify tank contents in-place in the treatment area, and dispose of the excavated soils off-site at a commercial low-level radioactive waste disposal facility.

The soil excavation, in situ vitrification of tank contents, and soil disposal alternatives are discussed in the following subsections.

Table 12-24. Alternative 4b: NPV for TSF-26.

Site	NPV ($)
TSF-26 (PM-2A V-13 and V-14)	8,833,063

12.6.5.1 Alternative 5a: Soil Excavation, In situ Vitrification of Tank Contents, and On-site Soil Disposal. Alternative 5a would consist of vitrifying the tank contents in-place and disposal of the excavated soils (i.e., soils outside the treatment area) on-site at the proposed ER INEEL soil repository. Contaminated soils above the tanks would be excavated. Soil surrounding the tanks would be vitrified in place along with the tank contents by establishing two planar shaped ISV melts, on opposite sides of the tanks which grow together and process the tank and its contents along with the surrounding soil as melting progresses. Contaminated soils would be excavated using standard construction equipment. Excavated soils would be transported to the proposed soil repository for disposal. During excavation activities, all uncontaminated soils would be stockpiled on site and replaced into the excavated area following removal of radionuclide-contaminated soil. Verification sampling outside the treatment area would be conducted to ensure that all contamination present at concentrations exceeding PRGs was removed. The excavated areas would be backfilled with clean soils after excavation and revegetated to natural conditions. Environmental monitoring would be conducted following completion of the remedial action to confirm no contaminant migration from the treatment area is occurring. This monitoring may consist of the placement of boreholes and/or monitoring wells through the treated waste form to the underlying soils. In addition, five-year site reviews would be conducted to evaluate the effectiveness of the institutional controls and the need for further environmental monitoring, or additional control measures as applicable. Five-year site reviews would be conducted for a 100 year period. Implementation of this alternative likely prevents return of this site to unrestricted use; however treated tank contents will be at depths greater than 10 feet.

Conventional excavation and transportation equipment and procedures would be used under this alternative. Supplied air and shielding in the form of leaded windows and lead lining on exterior facing surfaces of the equipment would be used as needed. Excavation equipment modified with positive-pressure ventilation system cabs and HEPA filters for use in radioactively-contaminated areas is available at the INEEL from previous remedial actions. If not available onsite, excavation equipment may be supplied by a subcontractor or may be purchased from vendors. However, modification of subcontractor or purchased equipment may be necessary for use in a radioactively-contaminated environment.

A cold test (i.e., mock-up simulation of the TSF-09/18 V-9 tank and contents) will be performed to obtain the information to support the remedial design. Following a successful cold test, the actual TSF-09/18 V-9 tank will be processed, followed by the other TSF-09/18 tanks. The TSF-26 tanks (PM-2A V-13 and V-14) will follow. Equipment to conduct the cold test and actual vitrification would be supplied by a subcontractor and is assumed to be appropriately modified to perform in a radiologically contaminated environment. Equipment to conduct the vitrification would be supplied by a subcontractor. Site preparation includes grading and leveling of the site east of the PM-2A tanks, providing adequate power to the site (i.e., 12.8 or 13.2 KVA). Additionally, it is assumed that the in situ vitrification system will require an off gas treatment system to treat contaminated vapors produced by the vitrification process, but that it will not require secondary containment or a weatherproof enclosure.

At TSF-26, it is estimated that five distinct areas of radionuclide-contaminated soil exist. The radionuclide-contaminated soils above the PM-2A V-13 and V-14 tanks, estimated to be approximately 18 × 12 m (60 × 40 ft), would be removed along with radionuclide-contaminated soils outside the treatment area prior to vitrification. The soils surrounding the tanks will be vitrified along with the tank contents. Radionuclide-contaminated soils within the other areas of TSF-26 to be removed would also be excavated to a depth of 3 m (10 ft).

12.6.5.1.1 Overall Protection of Human Health and the Environment—Under this alternative, human health and environmental risks would be reduced by preventing direct exposure to radionuclides in soils and preventing the potential direct exposure or release of the tank contents at TSF-26. Removal of radionuclide-contaminated soil and in-place treatment of tank contents and soils within the treatment area would provide long-term protection form direct exposure and contaminant migration because the vitrified mass would be greater than 3.4 m (10 ft) bgs. Therefore, this alternative meets specified RAOs and provides for overall protection of human health and the environment at TSF-26.

12.6.5.1.2 Compliance with ARARs and TBCs—Table 12-1 presents the evaluation of this alternative for compliance with the ARARs and TBCs. IDAPA 16.01.01650, 16.01.01161, and Air Toxics Rules applies to TSF-26 if they were a source of fugitive dust and are ARARs that would be met by performing excavation using water sprays and other techniques for dust suppression. Air Toxics Rules also apply to the off-gas treatment system to treat gas generated from the vitrification process. 40 CFR 122.26, which regulates stormwater and associated discharges would be met through engineering controls of surface water runoff. Hazardous waste rules would most likely apply to the treated tank contents and would be met through proper treatment and disposal methods. In addition, the waste and residues must be disposed of in accordance with the land disposal restrictions, 40 CFR 268. If the tank contents are determined to contain PCBs over 50 ppm, compliance with TSCA regulations will also be required. This alternative would meet all ARARs and TBCs through proper waste management techniques. DOE Orders would be met because health risks to current and future workers and potential residents would be within allowable ranges.

12.6.5.1.3 Long-Term Effectiveness and Permanence—This alternative provides for long-term and permanent prevention of human and environmental exposure to tank contents and radionuclide-contaminated soils at TSF-26. The long-term risk to human health and the environment from radionuclide-contaminated soils is basically transferred from TSF-26 to the managed on-site disposal facility. However, management practices at the disposal facility would be in place to ensure minimal risks to human health and the environment. Because potential residential exposure to contaminants in soil and tank contents at TSF-26 is prevented, the long-term effectiveness and permanence of Alternative 5a is considered high.

12.6.5.1.4 Reduction of Toxicity, Mobility, or Volume Through Treatment—Under this alternative no treatment is specified for radionuclide-contaminated soils. However, in situ treatment of tank contents via vitrification is specified. In situ vitrification of tank contents would likely result in a reduction of contaminant mobility. Additionally, a volume reduction of the tank contents would likely be realized due to removal of intergranular voids in the tanks and surrounding soils. The toxicity of the treated tank contents is likely to be relatively unaffected by vitrification. Contaminant mobility of radionuclide-contaminated soils would be minimized at the on-site disposal facility through the continuation of existing management practices.

12.6.5.1.5 Short-Term Effectiveness—The exposure risk to workers during soil excavation and vitrification of soil and tank contents at TSF-26 could be significant; however, direct contact with the tank waste will not occur and radiation monitoring and control measures have been demonstrated to effectively mitigate risks. Short-term effectiveness is therefore assessed as moderate. Equipment operator and worker exposures would be minimized to the extent possible using established procedures. Supplied air and shielding in the form of leaded windows and lead lining on exterior facing surfaces of the equipment would be used as needed. Excavation equipment modified with positive-pressure ventilation system cabs and HEPA filters for use in radioactively-contaminated areas is available at the INEEL from previous remedial actions. If not available onsite, excavation equipment may be supplied by a subcontractor or may be purchased from vendors. However, modification of subcontractor or purchased equipment may be necessary for use in a radioactively-contaminated environment. The activities associated with removing these soils would require exposure to radioactive materials. The operator risk would be directly related to the time required to perform the excavation. Exposure and risk per operator could be decreased by increasing the number of equipment operators, and decreasing the time spent on site by any one person.

Nonexposure risks to workers are also a consideration during excavation and vitrification. These risks result primarily from physical construction hazards, such as vehicle accidents or personnel injuries. However, implementation of appropriate health and safety measures for the excavation and treatment activities can minimize these risks.

Environmental impacts resulting from this alternative are dependent on the remedial design and required access areas. The surrounding landscape would likely be disturbed because of the equipment and vehicles moving in and around the site. However, the impact of these activities would be temporary, and the entire site would be restored to match the surrounding landscape at the completion of the project. No environmentally sensitive archaeological or historical sites, wetlands, or critical habitat exist at the OU 1-10 sites.

RAOs would be achieved by this alternative once excavation and disposal of soils at the on-site location is complete and treatment of the tank contents is complete. To satisfy DOE requirements during implementation of this alternative, exposures to equipment operators must be reduced below 25 mrem/yr.

***12.6.5.1.6* Implementability**—This alternative is technically feasible and has a moderate administrative feasibility. There are no site-specific conditions that exist at TSF-26 that would provide significant difficulty associated with soil excavation or transportation of soils to the proposed ER INEEL soil repository for disposal. Personnel, equipment and services associated with the soil excavation are readily available. Because of the length of the PM-2A tanks, the treatment will require two melts per tank. The off gas treatment system will have to be designed to collect vapors that might escape from both halves of the tank during the first vitrification stage. Long-term monitoring of the site would be required to verify the effectiveness of the vitrification process. Implementation of this alternative would be moderately difficult because of the complexity of the treatment system. Significant effort would be required to perform the necessary cold test(s), environmental assessments, safety analyses, permit preparation, and remedial design.

12.6.5.1.7 Cost—The costs associated with the in situ vitrification component of Alternative 5a include cold test (s) at the subcontractor site to support the remedial design of the process for this application, demonstration that regulatory cleanup standards are met, preparation of the necessary planning documents, obtaining necessary work approvals and permits, pretreatment of tank contents, and in situ vitrification of tank contents. The costs associated with the soil excavation component of Alternative 5a include excavation of radionuclide-contaminated soils at TSF-26 and on-site transport and disposal of soils at the proposed ER INEEL soil repository. The estimated NPV for is shown in Table 12-25. The alternative cost estimates are for comparison purposes only and not intended for budgetary, planning, or funding purposes.

Table 12-25. Alternative 5a: NPV for TSF-26.

Site	NPV ($)
TSF-26 (PM-2A V-13 and V-14)	13,574,740

12.6.5.2 *Alternative 5b: Soil Excavation, In Situ Vitrification Tank Contents, and Off-site Soil Disposal.* Alternative 5b would consist of vitrifying the tank contents in-place, and disposal of the excavated soils (i.e., soils outside the treatment area) off-site at a commercial disposal facility. Contaminated soils above the tanks would be excavated prior to initiating treatment and soils surrounding the tanks would be vitrified in place along with the tank contents. In situ vitrification will be achieved by establishing two planar shaped ISV melts, on opposite sides of the tanks which grow together and process the tank and its contents along with the surrounding soil as melting progresses. Contaminated soils outside the treatment area would be excavated using standard construction equipment. During excavation activities, all uncontaminated soils would be stockpiled on site and replaced into the excavated area following removal of radionuclide-contaminated soil. Excavated soils would be transported to a commercial low-level radioactive waste disposal facility. Compliance with appropriate, waste characterization and transportation requirements imposed by the facility would be required under this alternative. Verification sampling would be conducted outside the treatment area to ensure that all contamination present at concentrations exceeding PRGs was removed. The excavated areas would be backfilled with clean soils after excavation and revegetated to natural conditions. Environmental monitoring would be conducted following completion of the remedial action to confirm no contaminant migration from the tank area. This monitoring may consist of the placement of boreholes and/or monitoring wells through the treated waste form to the underlying soils. In addition, five-year site reviews would be conducted to evaluate the effectiveness of the institutional controls and the need for further environmental monitoring, or additional control measures as applicable. Five-year site reviews would be conducted for a 100-year period. Implementation of this alternative likely prevents return of this site to unrestricted use; however treated tank contents will be at depths greater than 10 feet.

Conventional excavation and transportation equipment and procedures would be used under this alternative. Supplied air and shielding in the form of leaded windows and lead lining on exterior facing surfaces of the equipment would be used as needed. Excavation equipment modified with positive-pressure ventilation system cabs and HEPA filters for use in radioactively-contaminated areas is available at the INEEL from previous remedial actions. If not available onsite, excavation equipment may be supplied by a subcontractor or may be purchased from vendors. However, modification of subcontractor or purchased equipment may be necessary for use in a radioactively-contaminated environment.

A cold test (i.e., mock-up simulation of the TSF-09/18 V-9 tank and contents) will be performed to obtain the information to support the remedial design. Following a successful cold test, the actual TSF-09/18 V-9 tank will be processed, followed by the other TSF-09/18 tanks. The TSF-26 tanks (PM-2A V-13 and V-14) will follow. Equipment to conduct the cold test and actual vitrification would be supplied by a subcontractor and is assumed to be appropriately modified to perform in a radiologically contaminated environment. Equipment to conduct the vitrification would be supplied by a subcontractor. Site preparation includes grading and leveling of the site east of the PM-2A tanks, providing adequate power to the site (i.e., 12.8 or 13.2 KVA). Additionally, it is assumed that the in situ vitrification system will require an off gas treatment system to treat contaminated vapors produced by the vitrification process, but that it will not require secondary containment or weatherproof enclosure.

At TSF-26, it is estimated that five distinct areas of radionuclide-contaminated soil exist. The radionuclide-contaminated soils above and surrounding the PM-2A V-13 and V-14 tanks, estimated to be approximately 18 × 12 m (60 × 40 ft), would be excavated prior to treatment of the tank contents. The soil surrounding the tanks will be vitrified along with the tank contents. Radionuclide-contaminated soils within the other areas of TSF-26 to be removed would also be excavated to a depth of 3 m (10 ft).

12.6.5.2.1 Overall Protection of Human Health and the Environment—Under this alternative, human health and environmental risks would be reduced by preventing the potential for direct exposure or release of the tank contents and preventing direct exposure to radionuclides in soils at TSF-26. Removal of radionuclide-contaminated soil and in-place treatment of tank contents would provide long-term protection form direct exposure and contaminant migration. Therefore, this alternative meets specified RAOs and provides for overall protection of human health and the environment at TSF-26.

12.6.5.2.2 Compliance with ARARs and TBCs—Table 12-1 presents the evaluation of this alternative for compliance with the ARARs and TBCs. IDAPA 16.01.01650, 16.01.01161, and Air Toxics Rules applies to TSF-26 if it was a source of fugitive dust and are ARARs that would be met by performing excavation using water sprays and other techniques for dust suppression. The Air Toxics Rules also applies to the off-gas treatment system to treat gases generated from the vitrification process. 40 CFR 122.26, which regulates stormwater and associated discharges would be met through engineering controls of surface water runoff. Hazardous waste rules would most likely apply to the treated tank contents and would be met through proper treatment methods. In addition, soils and residues must be disposed of in accordance with the land disposal restrictions, 40 CFR 268. If the tank contents are determined to contain PCBs over 50 ppm, compliance with TSCA regulations will also be required. This alternative would meet all ARARs and TBCs through proper waste management techniques. DOE Orders would be met because health risks to current and future workers and potential residents would be within allowable ranges.

12.6.5.2.3 Long-Term Effectiveness and Permanence—This alternative provides for long-term and permanent prevention of human and environmental exposure to tank contents and radionuclide-contaminated soils at TSF-26. The long-term risk to human health and the environment associated with the radionuclide-contaminated soil is basically transferred from TSF-26 to the managed off-site disposal facilities. However, existing management practices at the disposal facilities would be continued to ensure minimal risks to human health and the environment. Because potential residential exposure to contaminants in soil and tank contents at and TSF-26 (PM-2A V-13 and PM-2A V-14) is prevented, the long-term effectiveness and permanence of Alternative 5b is considered high.

12.6.5.2.4 Reduction of Toxicity, Mobility, or Volume Through Treatment—Under this alternative no treatment is specified for radionuclide-contaminated soils. However, in situ treatment of tank contents and soils within the treatment area via vitrification is specified. In situ vitrification of tank contents and soils within the treatment area would likely result in a reduction of contaminant mobility. Additionally, a volume reduction of the tank contents would likely be realized due to removal of intergranular voids in the tanks and surrounding soils. The toxicity of the treated tank contents is likely to be relatively unaffected by vitrification. Contaminant toxicity, mobility, and volume of the excavated soils would be eliminated from TSF-26. However, contaminant toxicity, mobility, and volume would basically be transferred to the off-site disposal location. Contaminant mobility of radionuclide-contaminated soils would be minimized at the off-site disposal location through effective waste management practices.

12.6.5.2.5 Short-Term Effectiveness—The exposure risk to workers during excavation and removal of contaminated soil and in situ treatment of tank contents at TSF-26 could be significant; however, direct exposure to the tank contents will not occur and radiation monitoring and control measures have been demonstrated to effectively mitigate risks. Short-term effectiveness is therefore assessed as moderate. Equipment operator exposures would be minimized to the extent possible using established procedures. Supplied air and shielding in the form of leaded windows and lead lining on exterior facing surfaces of the equipment would be used as needed. Excavation equipment modified with positive-pressure ventilation system cabs and HEPA filters for use in radioactively-contaminated areas is available at the INEEL from previous remedial actions. If not available onsite, excavation equipment may be supplied by a subcontractor or may be purchased from vendors. However, modification of subcontractor or purchased equipment may be necessary for use in a radioactively-contaminated environment. The activities associated with removing these soils would require exposure to radioactive materials. The operator risk would be directly related to the time required to perform the excavation. Exposure and risk per operator could be decreased by increasing the number of equipment operators, and decreasing the time spent on site by any one person.

Nonexposure risks to workers are also a consideration during excavation and treatment. These risks result primarily from physical construction hazards, such as vehicle accidents or personnel injuries. However, implementation of appropriate health and safety measures for the excavation and treatment activities can minimize these risks.

Environmental impacts resulting from this alternative are dependent on the remedial design and required access areas. The surrounding landscape would likely be disturbed because of the equipment and vehicles moving in and around the site. However, the impact of these activities would be temporary, and the entire site would be restored to match the surrounding landscape at the completion of the project. No environmentally sensitive archaeological or historical sites, wetlands, or critical habitat exist at the OU 1-10 sites.

RAOs would be achieved by this alternative once excavation and disposal at the on-site location is complete. To satisfy DOE requirements during implementation of this alternative, exposures to equipment operators must be reduced below 25 mrem/yr.

12.6.5.2.6 Implementability—This alternative is technically feasible and has a moderate administrative feasibility. There are no site-specific conditions that exist at TSF-26 that would provide significant difficulty associated with soil excavation or transportation of soils to the proposed ER INEEL soil repository for disposal. Personnel, equipment and services associated with the soil excavation are readily available. Because of the length of the PM-2A tanks, the treatment will require two melts per tank. The off gas treatment system will have to be designed to collect vapors that might escape from both halves of the tank during the first vitrification stage. Long-term monitoring of the site would be required to verify the effectiveness of the vitrification process. Implementation of this alternative would be moderately difficult because of the complexity of the treatment system. Significant effort would be required to perform the necessary cold test(s), environmental assessments, safety analyses, permit preparation, and remedial design.

12.6.5.2.7 Cost—The costs associated with the in situ vitrification component of Alternative 5b include cold test (s) at the subcontractor site to support the remedial design of the process for this application, demonstration that regulatory cleanup standards are met, preparation of the necessary planning documents, obtaining necessary work approvals and permits, pretreatment of tank contents, and in situ vitrification of tank contents. The costs associated with the soil excavation component Alternative 5b include excavation of radionuclide-contaminated soils at TSF-26 and off-site transport and disposal of soils at a commercial facility. The estimated NPV for each is shown in Table 12-26. The alternative cost estimates are for comparison purposes only and not intended for budgetary, planning, or funding purposes.

Table 12-26. Alternative 5b: NPV for TSF-26.

Site	NPV ($)
TSF-26 (PM-2A V-13 and V-14)	16,281,032

12.6.6 Summary of Individual Analysis for TSF-26

Detailed analysis of tank contents will be performed when the results of the treatability study are available.

12.7 Comparative Analysis of Alternatives for TSF-26

The comparative analysis provides a measure of the relative performance of alternatives against each evaluation criterion. The purpose of this comparison is to identify the relative advantages and disadvantages associated with each alternative. The comparative analysis does not identify a preferred alternative, but provides sufficient information to enable this selection by the appropriate decision makers (DOE-ID, EPA, and IDHW). The following sections present the alternative comparisons relative to each evaluation criterion, for each grouping of sites. Table 12-27 summarizes how each alternative satisfies the RAOs identified in Section 9.1. Table 12-28 summarizes the relative ranking of alternatives.

Each of the evaluation criteria is discussed in the following subsections.

12.7.1 Overall Protection of Human Health and the Environment

The primary measure of this criterion is the ability of an alternative to achieve RAOs. Table 12-27 provides a summary of the comparison of alternatives with RAOs.

12.7.2 Compliance with ARARs

Each alternative evaluated to address contaminated soils, tank, and tank contents would likely meet the ARARs and TBCs triggered under each alternative. Therefore, all alternatives are similarly ranked with respect to compliance with ARARs.

12.7.3 Long-Term Effectiveness and Permanence

Alternatives 2a, 2b, and 2c provide the highest degree of long-term effectiveness and permanence for contaminated soils and tank contents at TSF-26, because contaminated soil, tanks, and tank contents are removed from the site, tanks and tank contents are treated and placed in a managed disposal unit. Alternatives 3a, 3b, and 3c are the next highest ranked alternatives with respect to long-term effectiveness and permanence. These alternatives are lower ranked than Alternative 2a, 2b, and 2c because they do not involve removal of the tanks themselves and the contaminated soils surrounding the tanks. Alternatives 4a, 4b, 5a and 5b are lower ranked than Alternatives 3a, 3b, and 3c because they do not involve removal of the tank contents, only treatment. As result of treating the tank contents in place under Alternatives 4a, 4b, 5a, and 5b long-term monitoring and management is required to verify that RAOs continue to be met over time. Alternative 1 is the lowest ranked alternative because contaminated soils, tanks, and tank contents are not removed or treated at TSF-26. In addition, there is considerable long-term monitoring and management required under Alternative 1.

12.7.4 Reduction of Toxicity, Mobility, or Volume through Treatment

Alternatives 2a, 2b, and 2c provide the highest degree of reduction in toxicity, mobility, or volume at TSF-26 because tanks and tank contents are treated on or off site and placed in a managed disposal unit

Table 12-27. RAO summary for tank alternatives.

Criteria	Alternative 1 No Action/Limited Action	Alternative 2a Soil Exc./Tank Removal/On-Site Treatment and Disposal	Alternative 2b Soil Exc./Tank Removal/Off-Site Disposal	Alternative 2c Soil Exc./Tank Removal/On-Site Treatment and Disposal	Alternative 3a Soil Exc./Tank Content Removal/ On-Site Treatment and Disposal	Alternative 3b Soil Exc./Tank Content Removal/ On-Site Treatment/ Off-Site Disposal	Alternative 4a Soil Exc./In Situ Treatment of Tank Contents/On-Site Soil Disposal	Alternative 4b Soil Exc./In Situ Treatment of Tank Contents/Off-Site Soil Disposal	Alternative 5a Soil Exc./In Situ Vitrification of Tank Contents/On-Site Soil Disposal	Alternative 5b Soil Exc./In Situ Vitrification of Tank Contents/Off-Site Soil Disposal
RAOs for contaminated soil										
Prevention of exposure	Limits direct exposure to contaminated soils by imposing access restrictions.	Prevents direct exposures to contaminated soils through removing contamination above PRGs, treatment of tank contents, and on-site disposal.	Prevents direct exposures to contaminated soils through removing contamination above PRGs, treatment of tank contents and off-site disposal.	Prevents direct exposure to contaminated soils through removing contamination above PRGs, off-site treatment of tank contents, and off-site disposal	Prevents direct exposures to contaminated soils through removing soil contamination above PRGs and tank contents, in situ decontamination of tanks, treatment of tank contents, and on-site disposal.	Prevents direct exposures to contaminated soils through removing soil contamination above PRGs and tank contents, in-situ decontamination of tanks, treatment of tank contents, and off-site disposal.	Limits direct exposure to contaminated soils through removing contaminated soils and disposing on-site, and treating tank contents in place.	Limits direct exposure to contaminated soils through removing contaminated soils and disposing off-site, and treating tank contents in place.	Limits direct exposure to contaminated soils through removing contaminated soils and disposing on-site, and treating tank contents in place.	Limits direct exposure to contaminated soils through removing contaminated soils and disposing off-site, and treating tank contents in place.
Prevention of ingestion	Limits ingestion by imposing access restrictions.	Ingestion prevented by removing contaminated soils and tanks/tank contents, treatment of tank contents, and on-site disposal.	Ingestion prevented by removing contaminated soils and tanks/tank contents, treatment of tank contents, and off-site disposal.	Ingestion prevented by removing contaminated soils and tanks/tank contents, off-site treatment of tank contents and off-site disposal.	Ingestion prevented by removing contaminated soils and tank contents, decontamination of tanks, treatment of tank contents and on-site disposal.	Ingestion prevented by removing contaminated soils and tank contents, in-situ decontamination of tanks, treatment of tank contents, and off-site disposal.	Ingestion prevented by removing contaminated soils and isolating contamination in solidified mass within tanks.	Ingestion prevented by removing contaminated soils and isolating contamination in solidified mass within tanks	Ingestion prevented by removing contaminated soils and isolating contamination in solidified mass.	Ingestion prevented by removing contaminated soils and isolating contamination in solidified mass.
RAOs for tank contents										
Prevent release of COCs to the environment	Does not prevent potential release of COCs to the environment	Eliminates potential release to environment through removal of contaminated soil, tanks, and tank contents.	Eliminates potential release to environment through removal of contaminated soil, tanks, and tank contents.	Eliminates potential release to environment through removal of contaminated soil, tanks, and tank contents.	Eliminates potential release to environment through removal of contaminated soil and tank contents. Decontaminated tanks remain in place.	Eliminates potential release to environment through removal of contaminated soil and tank contents. Decontaminated tanks remain in place.	Reduces potential release of contaminants to environment through removal of contaminated soils and treatment of tank contents in place.	Reduces potential release of contaminants to environment through removal of contaminated soils and treatment of tank contents in place	Reduces potential release of contaminants to environment through removal of contaminated soils and treatment of tank contents in place.	Reduces potential release of contaminants to environment through removal of contaminated soils and treatment of tank contents in place

Table 12-28. Summary of comparative analysis of alternatives.

Criterion	Alternative 1 No Action/Limited Action	Alternative 2a Soil Exc./Tank Removal/ On-Site Treatment and Disposal	Alternative 2b Soil Exc./Tank Removal/ On-Site Treatment Off-Site Disposal	Alternative 2c Soil Exc./Tank Removal/ Off-Site Treatment and Disposal	Alternative 3a Soil Exc./Tank Content Removal/ On-Site Treatment and Disposal	Alternative 3b Soil Exc./Tank Content Removal/ On-Site Treatment/ Off-Site Disposal	Alternative 4a Soil Exc./In Situ Treatment of Tank Contents/On-Site Soil Disposal	Alternative 4b Soil Exc./In Situ Treatment of Tank Contents/Off-Site Soil Disposal	Alternative 5a Soil Exc./In Situ Treatment of Tank Contents/On-Site Soil Disposal	Alternative 5b Soil Exc./In Situ Treatment of Tank Contents/Off-Site Soil Disposal
Overall Protection of Human Health and the Environment	–	0	+	+	0	+	0	+	0	+
Compliance with ARARs	+	+	+	+	+	+	+	+	+	+
Long-Term Effectiveness and Permanence	–	+	+	+	+	+	0	0	0	0
Reduction of Toxicity, Mobility, or Volume through Treatment	–	+	+	+	0	0	0	0	+	+
Short-Term Effectiveness	+	–	–	–	0	0	+	+	+	+
Implementability	+	0	0	0	–	–	+	+	+	+
Cost	+	0	–	NA	0	–	+	–	–	–

NA= Costs not estimated.

\+ Favorable relative ranking

0 Neutral relative ranking

– Unfavorable relative ranking

(either on or off site). Alternatives 3a, 3b, 3c, 4a, 4b, 5a, and 5b are the next highest ranked alternatives with respect to reduction in toxicity, mobility, or volume. These alternatives are lower ranked than Alternative 2a, 2b, and 2c because they do not involve removal and decontamination of the tanks themselves. Alternative 5a and 5b are ranked higher because of the presumed volume reduction achieved by in situ vitrification. Alternative 1 is the lowest ranked alternative because tanks and tank contents are not removed or treated at TSF-26 under this alternative.

12.7.5 Short-Term Effectiveness

Alternative 1 would likely result in no significant impacts to worker health and safety or the environment. Therefore, this alternative has the highest degree of short-term effectiveness. Alternatives 4a and 5a are the next highest ranked alternative with respect to short-term effectiveness. Under Alternatives 4a and 5a tank contents are not directly contacted because they are treated in place. Alternatives 4b and 5b also would not involve direct contact with tank contents; however, under Alternatives 4b and 5b off-site transportation and disposal of contaminated soils is required. Therefore, Alternative 4b and 5b are slightly lower ranked than Alternative 4a and 5a. Alternative 3a is lower ranked than Alternative 4b and 5b because it involves direct contact with tank contents. Alternative 3b is slightly lower ranked than Alternative 3a because it involves off-site transportation and disposal of contaminated soils and tank contents. Alternative 3c is slightly lower ranked than Alternative 3b because off-site transportation of untreated contaminated soils and tank contents is required. Alternative 2a is lower ranked than Alternative 3b because this alternative includes removal of the tanks themselves and a greater volume of contaminated soils than under Alternative 3b. Alternative 2b is slightly lower ranked than Alternative 2a because it involves off-site transportation and disposal of contaminated soils and tank contents. Alternative 2c is slightly lower ranked than Alternative 2b because off-site transportation of untreated contaminated soils and tank contents is required.

12.7.6 Implementability

Alternative 1 has the highest degree of technical and administrative feasibility because no remedial action is conducted under that alternative. Installation of a perimeter security fence, imposing legal restrictions, and continuation of existing environmental monitoring are not anticipated to present significant technical or administrative difficulties. Alternatives 4b and 5b are the next highest ranked alternative with respect to implementability. It is lower ranked than Alternative 1 because it involves in place treatment of tank contents and off-site disposal of contaminated soils. Alternatives 4a and 5a are lower ranked than Alternatives 4b and 5b because they include disposal of contaminated soils at a proposed on-site soil repository which has not been constructed. Alternative 2b is lower ranked than Alternatives 4a and 5a because it involves the complete removal of tanks, tank contents, and contaminated soils and off-site disposal. Alternative 2c is lower ranked than Alternative 2b because special containers and transportation procedures are required to transport the untreated tank contents to an off-site treatment and disposal facility. Alternative 2a is lower ranked than Alternative 2c because it includes disposal of contaminated soils and treated tank contents at a proposed on-site soil repository which has not yet received approval for construction. Alternative 3b is lower ranked than Alternative 2a because it includes remote removal operations for removal of the tank contents. Alternative 3c is lower ranked than Alternative 3b because special containers and transportation procedures are required to transport the untreated tank contents to an off-site treatment and disposal facility. Alternative 3a is lower ranked than Alternative 3c because it includes disposal of contaminated soils at the proposed ER INEEL soil repository which has not yet received approval for construction.

12.7.7 Cost

The level of detail used to develop the cost estimates presented is considered appropriate for comparing alternatives. Separate cost line items are developed for the primary components of each remedial action alternative, such as monitoring; capping; excavation; disposal; and reporting requirements such as remedial design/remedial action scope of work, remedial design/remedial action work plans, safety documentation, and progress reports.

The level of detail presented in the cost estimates is consistent with the level of detail provided in the descriptions of each alternative. Additional details in the cost estimates are not considered appropriate without supporting detailed designs for each alternative. The uncertainty associated with each cost estimate increases with the complexity of the alternative.

Cost estimates have not been prepared for alternatives which include off-site treatment of contaminated soils or tank contents for TSF-26. This only affects Alternative 2c and 3c. As a result, cost estimates are not available for these alternatives.

Among the alternatives for which cost estimates are available, Alternative 5b is the most costly. It involves removal of contaminated soils, and in situ vitrification of the tanks and tank contents and off-site soil transport and disposition. The next most expensive is Alternative 2b which involves removal of the tanks and tank contents; on-site treatment of tank contents; and disposal of contaminated soils at the proposed ER INEEL soil repository and treated tank contents at RWMC. Alternative 3b is the next most costly alternative. Alternative 3b includes . removal of contaminated soils, tank contents; on-site treatment of tank contents; and disposal of both off-site. Under Alternative 4a contaminated soils are removed and disposed in the proposed ER soil repository and the tank contents are treated in place while 4b proposes off-site disposal of soil. Alternative 4b is the next most costly alternative followed by 2a, 3a, and 4a. Alternative 1 is the least costly alternative evaluated to address tank contents and contaminated soils at TSF-26. Alternative 1 involves installation of a perimeter security fence, imposing legal restrictions, and continuation of existing environmental monitoring at TSF-26.

12.7.8 Summary of Comparative Analysis of Alternatives

A summary of the comparative analysis of remedial action alternatives for OU 1-10 tank contents sites is located in Table 12-28. Relative rankings were assigned to each alternative based on the various evaluation criteria. A value of "+" indicates a favorable ranking relative to other alternatives for that criteria. A value of "0" indicates a neutral relative ranking and a value of "–" indicates an unfavorable ranking relative to other alternatives.

12.8 Individual Analysis of Alternatives for TSF-09/18

In accordance with CERCLA RI/FS guidance, remedial action alternatives retained for detailed analysis are individually assessed against the evaluation criteria listed in Section 12.1, not including state and community acceptance. The individual analysis of each alternative developed to address tank waste liquids, sludge, and contaminated soils at TSF-09/18 (V-tanks V-1, V2, V-3, and V-9) is discussed in the following subsections.

12.8.1 Alternative 1: No Action/Limited Action

The No Action/Limited Action alternative is presented to comply with requirements of the NCP [40 CFR 300.430 (e)(6)] and guidance for conducting feasibility studies under CERCLA (EPA 1988). The No Action/Limited Action alternative provides a baseline with which other alternatives can be compared. Under this alternative, existing management practices currently in place at TSF-09/18 would be continued with the addition of expanded environmental monitoring and the implementation of institutional controls.

Existing management practices include environmental monitoring in accordance with INEEL site-wide requirements under the RESP and SESP. Monitoring activities may consist of the collection and analysis of air, groundwater, soil, biota, and other media from the site as applicable. Air monitoring may include the use of high- and low-volume air samplers to determine if fugitive radionuclides escape sites where contaminated surface soils exist. Groundwater monitoring may include monitoring contaminant migration in groundwater beneath the site. Soil monitoring would include radiation surveys over and around sites where contaminated soil and debris are left in place, to evaluate if contaminants have been mobilized to the surface.

Institutional controls implemented at these subsites would consist of restricting access to the sites using controls such as fencing and legal land-use restrictions. Surface water diversion controls would also be implemented as appropriate. In addition, five-year site reviews would be conducted to evaluate the effectiveness of the institutional controls and the need for further environmental monitoring, or additional control measures, as applicable. Five-year site reviews would be conducted for a duration of 100 years. The details associated with implementation of this alternative for TSF-09/18 are discussed in the following paragraph.

At TSF-09/18, environmental monitoring would be continued. Current management practices such as restricting activities conducted at TSF-09/18 without clearance from the INEEL ER directorate would also be continued. A perimeter security fence with appropriate signage would be installed around the portion of TSF-09/18 with soil concentrations above PRGs.

12.8.1.1 Overall Protection of Human Health and the Environment. Under the No Action/Limited Action alternative, human health and environmental risks and would be reduced in the short-term by preventing direct exposure to radionuclides in soils and tank contents at TSF-09/18. Continuation of environmental monitoring, installation of a perimeter security fence and imposing legal restrictions meets specified RAOs and provides for overall protection of human health and the environment in the short-term at TSF-09/18. However, due to uncertainties associated with the integrity of the tanks, the No Action/Limited Action alternative would most likely not meet RAOs and provide for protection of human health and the environment in the long-term.

12.8.1.2 Compliance with ARARs and TBCs. Table 12-1 presents the evaluation of the No Action/Limited Action alternative for compliance with the ARARs and TBCs. This alternative does not involve any construction or operational activities that would result in disturbances to the surfaces at TSF-09/18. IDAPA 16.01.01650 could nonetheless apply to the subsites if they were a source of fugitive dust. However, modeled BRA results indicate that this ARAR would be met. IDAPA 16.01.01161 would also be met by this alternative. 40 CFR 122.26, regulating stormwater and associated discharges, would similarly apply. Health risks to current workers would be within acceptable ranges under this alternative. In addition, this alternative would meet DOE Orders because health risks to potential future workers and residents would be within allowable ranges.

12.8.1.3 Long-Term Effectiveness and Permanence. This alternative does not provide for long-term and permanent control of human and environmental exposure to radionuclide-contaminated soils at TSF-09/18. This alternative provides some long-term control of human and environmental contact with contaminated soils, but provides no measures to prevent release of contaminants from the tanks. Therefore, since potential releases of contaminants from the tanks are not prevented, the long-term effectiveness and permanence of the limited action alternative is considered low.

12.8.1.4 Reduction of Toxicity, Mobility, or Volume Through Treatment. No treatment is associated with this alternative. Toxicity, mobility, and volume of contaminated soils would remain unchanged.

12.8.1.5 Short-Term Effectiveness. This alternative can be readily implemented without additional risks to the community, workers, or the environment. No specialized equipment, personnel, or services are required to implement the limited action alternative. The short-term effectiveness of this alternative is considered high.

12.8.1.6 Implementability. This alternative is technically feasible and has a moderate administrative feasibility. There are no site-specific conditions that exist at TSF-09/18 that would inhibit environmental monitoring or perimeter security fence installation activities. However, long-term management and monitoring would be required. Although not anticipated, if opposition to access restrictions occurs , gaining approval of access restrictions could be administratively difficult. Equipment and materials required for implementation of this alternative are readily available. Implementability of the No Action/Limited Action alternative is considered high.

12.8.1.7 Cost. The costs associated with the No Action/Limited Action alternative include installation of a perimeter security fence, installation of surface water diversion controls, imposing legal restrictions, conducting periodic monitoring activities, and conducting five-year site reviews for a period of 100 years. Estimated NPVs are shown in Table 12-29 for each subsite. Post-closure costs were estimated for a 100-year monitoring period. The alternative cost estimates are for comparison purposes only and not intended for budgetary, planning, or funding purposes.

12.8.2 Alternative 2: Soil Excavation, Tank Removal, Ex Situ Treatment and Disposal

Two alternatives were developed to address contaminated soils and tank waste at TSF-09/18 which involve soil excavation, tank removal, ex-situ treatment (various options) and disposal:

- Excavate contaminated soils, excavate tanks and their contents, treat tank contents on-site (5 options), and dispose of the treated material at RWMC and excavated soils at the proposed ER INEEL soil repository.

- Excavate contaminated soils, excavate tanks and their contents, treat tank contents off-site, stabilize residues and dispose of the residues at RWMC and excavated soils at the proposed ER INEEL soil repository.

Table 12-29. Alternative 1: NPV for TSF-09/18.

Site	NPV ($)
TSF-09/18 (V-tanks V1, V2, V-3, and V-9)	1,383,895

The soil excavation, tank removal, ex situ treatment, and disposal alternatives are discussed in the following subsections:

12.8.2.1 Alternative 2a: Soil Excavation, Tank Removal, and On-site Treatment and Disposal. Alternative 2a would consist of excavation of the tanks and their contents, on-site treatment of the tank contents , disposal of the excavated soils on-site at the proposed ER INEEL soil repository, and disposal of the treated tank contents at the RWMC. The tanks and contaminated soils surrounding the tanks would be removed using standard excavation equipment. Tank contents would be removed remotely by jetting and pumping, or vacuum removal and the tanks would be decontaminated in-place prior to removal. The treated waste must conform to the U.S. NRC's Branch Technical Position on Waste Form which specifies limits on the leachability of contaminants and the structural stability of the material. Water generated during excavation and treatment activities , if any, would be characterized and disposed of appropriately at the ICPP PEW System.

The following on-site treatment options are considered:

1. Option 2a1—Solidify/Stabilize tank contents without solid/liquid separation.

2. Option 2a2—Solidify/Stabilize tank contents with solid/liquid separation prior to solidification/stabilization

3. Option 2a3—Storage of tank waste at RWMC in HICs followed by thermal treatment and ultimate disposal at RWMC.

4. Option 2a4—Solid/liquid separation followed by treatment of liquids using reverse osmosis (RO) and treatment of solids by solidification/stabilization.

5. Option 2a5—Solid/liquid separation followed by treatment of liquids using evaporation/carbon adsorption and treatment of solids by solidification/stabilization.

Conventional excavation and transportation equipment and procedures would be used under this alternative. Supplied air and shielding in the form of leaded windows and lead lining on exterior facing surfaces of the equipment would be used as needed. Excavation equipment modified with positive-pressure ventilation system cabs and HEPA filters for use in radioactively-contaminated areas is available at the INEEL from previous remedial actions. If not available onsite, excavation equipment may be supplied by a subcontractor or may be purchased from vendors. However, modification of subcontractor or purchased equipment may be necessary for use in a radioactively-contaminated environment.

During excavation activities, all uncontaminated soils (i.e., soils meeting PRGs) would be stockpiled on site and replaced into the excavated area following removal of radionuclide-contaminated soil. Excavated soils would then be transported to the proposed ER INEEL soil repository for disposal, and treated tank contents would be transported to the RWMC for disposal. Verification sampling would be conducted to ensure that all contamination present at the subsites with concentrations exceeding PRGs was removed. The excavated areas would be backfilled with clean soils to natural grade and revegetated. Institutional controls would not be required after site excavation and disposal, since all contamination would be removed, and all exposure pathways would be eliminated.

At TSF-09/18, the estimated footprint of radionuclide-contaminated soils would be excavated (approximately 80 × 50 ft) to a depth of 20 ft. Tanks V1, V2, and V3 would be removed at TSF-09 and Tank V9 would be removed at TSF-18.

12.8.2.1.1 Overall Protection of Human Health and the Environment—Under this alternative, human health and environmental risks and would be reduced at TSF-09/18. The removal of radionuclide-contaminated soil and tank contents would eliminate potential long-term human health and environmental concerns associated with direct exposure or contaminant migration from uncontrolled radioactive waste disposal sites. Therefore, Alternative 2a and the associated treatment options meet specified RAOs and provides for long-term protection of human health and the environment at TSF-09/18.

12.8.2.1.2 Compliance with ARARs and TBCs—Table 12-1 presents the evaluation of this alternative for compliance with the ARARs and TBCs. IDAPA 16.01.01650, 16.01.01161, and Air Toxics Rules apply to TSF-09/18 if it was a source of fugitive dust and are ARARs that would be met by performing excavation using water sprays and other techniques for dust suppression. 40 CFR 122.26, which regulates stormwater and associated discharges, would be met through engineering controls of surface water runoff. Hazardous waste rules would most likely apply to the treated tank contents and would be met through proper treatment and disposal methods. Tank waste and residues must be disposed of in accordance with the land disposal restrictions, 40 CFR 268. If the treated tank contents are determined to contain PCBs over 50 ppm, compliance with TSCA regulations will also be required. DOE Orders would be met because health risks to current and future workers and potential residents would be within allowable ranges. This alternative and associated treatment options would meet all ARARs and TBCs.

12.8.2.1.3 Long-Term Effectiveness and Permanence—This alternative provides for long-term and permanent prevention of human and environmental exposure to tank contents and radionuclide-contaminated soils at TSF-09/18. The long-term risk to human health and the environment is basically transferred from TSF-09/18 to the managed on-site disposal facilities. However, existing management practices at the disposal facilities would be continued to ensure minimal risks to human health and the environment. Because potential residential exposure to contaminants in soil and tank content TSF-09/18 is prevented, the long-term effectiveness and permanence of Alternative 2a and associated treatment options is considered high.

12.8.2.1.4 Reduction of Toxicity, Mobility, or Volume Through Treatment—Under this alternative no treatment is specified for radionuclide-contaminated soils. However, treatment of tank contents via various options is specified. Contaminated materials would be physically removed and contained at centrally-managed on-site disposal locations. Contaminant mobility, toxicity and volume would be eliminated at the individual OU 1-10 sites, although toxicity would not be affected at the disposal location as part of this alternative. Contaminant mobility would be minimized at the disposal location through effective waste management practices. Treatment of tank contents prior to on-site disposal would likely result in additional reduction of contaminant mobility. However, depending on the treatment option, the treatment could result in an increase in volume of contaminated media.

12.8.2.1.5 Short-Term Effectiveness—The exposure risk to workers during excavation and removal of contaminated soil and debris at TSF-09/18 could be significant, however radiation monitoring and control measures have been demonstrated to effectively mitigate risks in previous INEEL removal actions. Short-term effectiveness is therefore assessed as moderate. Equipment operator exposures would be minimized to the extent possible using established procedures. Supplied air and shielding in the form of leaded windows and lead lining on exterior facing surfaces of the equipment would be used as needed.

Excavation equipment modified with positive-pressure ventilation system cabs and HEPA filters for use in radioactively-contaminated areas is available at the INEEL from previous remedial actions. If not available on-site, excavation equipment may be supplied by a subcontractor or may be purchased from vendors. However, modification of subcontractor or purchased equipment may be necessary for use in a radioactively-contaminated environment. The activities associated with removing these soils would require exposure to radioactive materials. The operator risk would be directly related to the time required to perform the excavation. Exposure and risk per operator could be decreased by increasing the number of equipment operators, and decreasing the time spent on site by any one person.

Nonexposure risks to workers are also a consideration during excavation. These risks result primarily from physical construction hazards, such as vehicle accidents or personnel injuries. However, implementation of appropriate health and safety measures for the excavation activities can minimize these risks.

Environmental impacts resulting from this alternative are dependent on the remedial design and required access areas. The surrounding landscape would likely be disturbed because of the equipment and vehicles moving in and around the site. However, the impact of these activities would be temporary, and the entire site would be restored to match the surrounding landscape at the completion of the project. No environmentally sensitive archaeological or historical sites, wetlands, or critical habitat exist at the OU 1-10 sites.

RAOs would be achieved by this alternative once excavation, treatment, and disposal at the on-site location is complete. Per DOE Order 5820.2A requirements during implementation of this alternative, exposures to equipment operators must be reduced below 25 mrem/yr.

12.8.2.1.6 Implementability—This alternative is technically feasible and has a moderate administrative feasibility. There are no site-specific conditions that exist at TSF-09/18 that would provide significant difficulty associated with soil and tank excavation, tank contents treatment, and transportation of soils and treated tank contents to the on-site disposal facility. Personnel, equipment and services associated with the soil and tank excavation portion of this alternative are readily available. Some specialized equipment associated with removal of the tank contents may be required. The implementation of this alternative would be moderately difficult because of the complexity of the retrieval system with respect to safety considerations and administrative constraints for on-site containment facility requirements. Significant effort would be required to perform environmental assessments, safety analysis, permit preparations, and equipment modifications (for operator safety), as well as system testing and demonstration.

12.8.2.1.7 Cost—The costs associated with Alternative 2a and associated treatment options include excavation of radionuclide-contaminated soils and tanks at TSF-09/18, removal and treatment of tank contents, on-site disposal of soils at the proposed ER INEEL soil repository, disposal of treated tank contents at the RWMC, backfilling of excavated areas, and grading and revegetating the sites to natural conditions. The estimated NPV is shown in Table 12-30. The alternative cost estimates are for comparison purposes only and not intended for budgetary, planning, or funding purposes.

12.8.2.2 Alternative 2b: Soil Excavation, Tank Removal, and Off-Site Treatment and On-Site Disposal of Treated Residuals. Alternative 2b would consist of excavation of the tanks and their contents, and transportation of the excavated materials to an Oak Ridge National Laboratory (ORNL) for treatment by incineration, stabilization of residuals, and disposal of residuals at RWMC. The tanks and contaminated soils surrounding the tanks would be excavated using standard construction equipment. Tank

Table 12-30. Alternative 2a and Treatment Options 2a1, 2a2, 2a3, 2a4, and 2a5: NPV for TSF-09/18.

Site	NPV ($)
Option 2a1, TSF-09/18 (V-tanks V1, V2, V3, and V9)	12,994,944
Option 2a2, TSF-09/18 (V-tanks V1, V2, V3, and V9)	10,242,269
Option 2a3, TSF-09/18 (V-tanks V1, V2, V3, and V9)	7,856,839
Option 2a4, TSF-09/18 (V-tanks V1, V2, V3, and V9)	13,461,979
Option 2a5, TSF-09/18 (V-tanks V1, V2, V3, and V9)	13,944,523

contents would be removed remotely by jetting and pumping, or vacuum removal and the tanks would be decontaminated in-place prior to removal. Soils and tank wastes would be dewatered to extract liquids introduced during removal operations, and the dewatered materials would be placed in HICs and transported to a commercial low-level radioactive waste disposal facility for treatment and disposal. Water generated during excavation and dewatering activities, if any, would be characterized and disposed of appropriately at the ICPP PEW System. It is noted that ORNL is (at present) not accepting out-of-state waste for treatment.

Conventional excavation and transportation equipment and procedures would be used under this alternative. Supplied air and shielding in the form of leaded windows and lead lining on exterior facing surfaces of the equipment would be used as needed. Excavation equipment modified with positive-pressure ventilation system cabs and HEPA filters for use in radioactively-contaminated areas is available at the INEEL from previous remedial actions. If not available onsite, excavation equipment may be supplied by a subcontractor or may be purchased from vendors. However, modification of subcontractor or purchased equipment may be necessary for use in a radioactively-contaminated environment.

Excavated soils would be transported to the proposed ER INEEL soil repository for disposal. Tank contents would be transported to ORNL for incineration and treated residuals would be transported back to INEEL to the RWMC for disposal. During excavation activities, all uncontaminated soils would be stockpiled on site and replaced into the excavated area following removal of radionuclide-contaminated soil. Verification sampling would be conducted to ensure that all contamination present at concentrations exceeding PRGs was removed. The excavated areas would be backfilled with clean soils after excavation and revegetated to natural conditions. Institutional controls would not be required after site excavation and disposal, since all contamination would be removed, and all exposure pathways would be eliminated. Compliance with appropriate waste characterization and transportation requirements imposed by the facility would be required for the tank contents and the treated residuals under this alternative.

At TSF-09/18, the estimated footprint of radionuclide-contaminated soils would be excavated (approximately 80 × 50 ft) to a depth of 20 ft. Tanks V1, V2, and V3 would be removed at TSF-09 and Tank V9 would be removed at TSF-18.

12.8.2.2.1 Overall Protection of Human Health and the Environment—Under this alternative, human health and environmental risks and would be reduced at TSF-09/18. The removal of radionuclide-contaminated soil and tank contents would eliminate potential long-term human health and environmental concerns associated with direct exposure or contaminant migration from uncontrolled radioactive waste disposal sites. Therefore, Alternative 2b meets specified RAOs and provides for long-term protection of human health and the environment at TSF-09/18.

12.8.2.2.2 Compliance with ARARs and TBCs—Table 12-1 presents the evaluation of this alternative for compliance with the ARARs and TBCs. IDAPA 16.01.01650, 16.01.01161, and Air Toxics Rules apply to TSF-09/18 if it was a source of fugitive dust and are ARARs that would be met by performing excavation using water sprays and other techniques for dust suppression. 40 CFR 122.26, which regulates stormwater and associated discharges would be met through engineering controls of surface water runoff. Hazardous waste rules would most likely apply to the treated tank contents and would be met through proper treatment and disposal methods. Tank waste and residues must be disposed of in accordance with the land disposal restrictions, 40 CFR 268. If the tank contents or treated residuals are determined to contain PCBs over 50 ppm, compliance with TSCA regulations will also be required. DOE Orders would be met because health risks to current and future workers and potential residents would be within allowable ranges. This alternative would meet all ARARs and TBCs.

12.8.2.2.3 Long-Term Effectiveness and Permanence—This alternative provides for long-term and permanent prevention of human and environmental exposure to tank contents and radionuclide-contaminated soils at TSF-09/18. The long-term risk to human health and the environment is basically transferred from TSF-09/18 to the managed off-site disposal facility. However, existing management practices at the disposal facility would be continued to ensure minimal risks to human health and the environment. Because potential residential exposure to contaminants in soil and tank contents at TSF-09/18 is prevented, the long-term effectiveness and permanence of Alternative 2c is considered high.

12.8.2.2.4 Reduction of Toxicity, Mobility, or Volume Through Treatment— Under this alternative no treatment is specified for radionuclide-contaminated soils. However, off-site treatment of tank contents and onsite disposal of treated residuals is specified. Contaminated materials would be physically removed and contained in a centrally-managed off-site disposal location as well as the treated residuals. Contaminant mobility, toxicity, and volume would be eliminated at the individual OU 1-10 sites, although toxicity would likely not be affected at the off-site disposal location as part of this alternative. Contaminant mobility would be minimized at the disposal location through effective waste management practices. Off-site treatment of tank contents prior to disposal of the treated residuals would likely result in additional reduction of contaminant mobility. Treatment of the tank contents and the resulting treated residual will likely result in a decrease in volume of contaminated media.

12.8.2.2.5 Short-Term Effectiveness—The exposure risk to workers during excavation and removal of contaminated soil and tanks at TSF-09/18 could be significant, however radiation monitoring and control measures have been demonstrated to effectively mitigate risks in previous INEEL removal actions. Short-term effectiveness is therefore assessed as moderate. Equipment operator exposures would be minimized to the extent possible using established procedures. Supplied air and shielding in the form of leaded windows and lead lining on exterior facing surfaces of the equipment would be used as needed. Excavation equipment modified with positive-pressure ventilation system cabs and HEPA filters for use in radioactively-contaminated areas is available at the INEEL from previous remedial actions. If not available onsite, excavation equipment may be supplied by a subcontractor or may be purchased from vendors. However, modification of subcontractor or purchased equipment may be necessary for use in a radioactively-contaminated environment. The activities associated with removing these soils would require Nonexposure risks to workers are also a consideration during excavation. These risks result primarily from physical construction hazards, such as vehicle accidents or personnel injuries. However, exposure to radioactive materials. The operator risk would be directly related to the time required to perform the excavation. Exposure and risk per operator could be decreased by increasing the number of equipment operators, and decreasing the time spent on site by any one person.

Implementation of appropriate health and safety measures for the excavation activities can minimize these risks.

Environmental impacts resulting from this alternative are dependent on the remedial design and required access areas. The surrounding landscape would likely be disturbed because of the equipment and vehicles moving in and around the site. However, the impact of these activities would be temporary, and the entire site would be restored to match the surrounding landscape at the completion of the project. No environmentally sensitive archaeological or historical sites, wetlands, or critical habitat exist at the OU 1-10 sites.

RAOs would be achieved by this alternative once excavation and disposal at the on-site location is complete. Per DOE Order 5820.2A requirements during implementation of this alternative, exposures to equipment operators must be reduced below 25 mrem/yr.

12.8.2.2.6 Implementability—This alternative is technically feasible and has a moderate administrative feasibility. There are no site-specific conditions that exist at TSF-09/18 that would provide significant difficulty associated with soil and tank excavation or transportation of soils and tank contents off-site for disposal. Implementation of this alternative would be moderately difficult because of the complexity of the retrieval system with respect to safety considerations and on-site containment requirements. Significant effort would be required to perform environmental assessments, safety analyses, permit preparations, and equipment modifications (for operator safety), as well as system testing and demonstration. Off-site transportation of untreated contaminated materials and treated residuals presents potential administrative constraints due to potential exposures to human receptors between INEEL and the treatment facility. The off-site treatment facility is located in Oak Ridge, Tennessee. Coordination would be required between INEEL and treatment facility personnel to ensure applicable criteria are met before contaminated materials are excavated for off-site transport and return of the treated material; however, (at present) the facility is not accepting out-of-state waste for treatment.

12.8.2.3 Cost—The costs associated with Alternative 2b include excavation of radionuclide-contaminated soils and tanks at TSF-09/18, removal and treatment of tank contents at ORNL, return of treated residuals to INEEL and on-site disposal of soils and treated tank contents residuals at the proposed ER INEEL soil repository and RWMC, respectively. Estimated total project costs are shown in Table 12-31

12.8.3 Alternative 3: Soil Excavation, In Situ Treatment of Tank Contents, and Soil Disposal

The following alternatives were developed to address tank waste at TSF-09 (V-1, V-2, and V-3) and TSF-18 (V-9):

Table 12-31. Alternative 2b: NPV for TSF-09/18.

Site	NPV ($)
TSF-09/18 (V-tanks V1, V2, V3, and V9)	8,233,720

- Excavate contaminated soils, grout tank contents in-place, and dispose of the excavated soils at the proposed ER INEEL soil repository.

- Excavate contaminated soils, grout tank contents in-place, and dispose of the excavated soils off-site at a commercial low-level radioactive waste disposal facility.

The soil excavation, in-situ treatment of tank contents, and soil disposal alternatives are discussed in the following subsections.

12.8.3.1 Alternative 3a: Soil Excavation, In-situ Treatment of Tank Contents, and On-site Soil Disposal. Alternative 3a would consist of grouting tank contents in-place, and disposal of the excavated soils on-site at the proposed ER INEEL soil repository. Contaminated soils surrounding the tanks would be excavated using standard construction equipment. Tank contents would be mechanically mixed and grouted in place remotely by mixing the tank contents and injecting grout into the tanks through existing sample ports. Excavated soils would be transported to the proposed soil repository for disposal. During excavation activities, all uncontaminated soils would be stockpiled on site and replaced into the excavated area following removal of radionuclide-contaminated soil. Verification sampling would be conducted to ensure that all contamination present at concentrations exceeding PRGs was removed. The excavated areas would be backfilled with clean soils after excavation and revegetated to natural conditions. Environmental monitoring to confirm no contaminant migration from the tank area would be conducted following completion of the remedial action. This monitoring may consist of the placement of boreholes and/or monitoring wells through the treated waste form to the underlying soils. In addition, five-year site reviews would be conducted to evaluate the effectiveness of the institutional controls and the need for further environmental monitoring, or additional control measures as applicable. Five-year site reviews would be conducted for a 100 year period. Implementation of this alternative likely prevents return of this site to unrestricted use; however treated tank contents will be at depths greater than 10 feet.

Conventional excavation and transportation equipment and procedures would be used under this alternative. Supplied air and shielding in the form of leaded windows and lead lining on exterior facing surfaces of the equipment would be used as needed. Excavation equipment modified with positive-pressure ventilation system cabs and HEPA filters for use in radioactively-contaminated areas is available at the INEEL from previous remedial actions. If not available onsite, excavation equipment may be supplied by a subcontractor or may be purchased from vendors. However, modification of subcontractor or purchased equipment may be necessary for use in a radioactively-contaminated environment.

At TSF-09/18, the estimated footprint of radionuclide-contaminated soils would be excavated (approximately 80 by 50 ft) to a depth of 20 ft. The contents of the tanks would be solidified in place by mixing the tank contents and injecting grout into existing openings in the tanks. An off gas collection system would be established to collect the vapors that would escape the tanks during the grouting process.

12.8.3.1.1 Overall Protection of Human Health and the Environment—Under this alternative, human health and environmental risks and would be reduced by preventing direct exposure to tank contents and radionuclides in soils at TSF-09/18. Removal of radionuclide-contaminated soil and in-place treatment of tank contents would provide long-term protection from direct exposure and contaminant migration. Therefore, this alternative meets specified RAOs and provides for overall protection of human health and the environment at TSF-09/18.

12.8.3.1.2 Compliance with ARARs and TBCs—Table 12-1 presents the evaluation of this alternative for compliance with the ARARs and TBCs. IDAPA 16.01.01650, 16.01.01161, and Air

Toxics Rules applies to TSF-09/18 if they were a source of fugitive dust and are ARARs that would be met by performing excavation using water sprays and other techniques for dust suppression. 40 CFR 122.26, which regulates stormwater and associated discharges would be met through engineering controls of surface water runoff. Hazardous waste rules would most likely apply to the treated tank contents and would be met through proper treatment and disposal methods. In addition, the waste and residues must be disposed of in accordance with the land disposal restrictions, 40 CFR 268. If the tank contents are determined to contain PCBs over 50 ppm, compliance with TSCA regulations will also be required. This alternative would meet all ARARs and TBCs through proper waste management techniques. DOE Orders would be met because health risks to current and future workers and potential residents would be within allowable ranges.

12.8.3.1.3 Long-Term Effectiveness and Permanence—This alternative provides for long-term and permanent prevention of human and environmental exposure to tank contents and radionuclide-contaminated soils at TSF-09/18. The long-term risk to human health and the environment from radionuclide-contaminated soils is basically transferred from TSF-09/18 to the managed off-site disposal facility. However, existing management practices at the disposal facilities would be continued to ensure minimal risks to human health and the environment. Because potential residential exposure to contaminants in soil and tank contents at TSF-09/18 is prevented, the long-term effectiveness and permanence of Alternative 3a is considered high.

12.8.3.1.4 Reduction of Toxicity, Mobility, or Volume Through Treatment—Under this alternative no treatment is specified for radionuclide-contaminated soils. However, in situ treatment of tank contents in place via solidification is specified. Solidification of tank contents in place would likely result in a reduction of contaminant mobility. However, solidification may result in an increase in volume of contaminated media. The toxicity of the treated tank contents is likely to be relatively unaffected by solidification. Contaminant mobility of radionuclide-contaminated soils would be minimized at the on-site disposal facility through the continuation of existing management practices.

12.8.3.1.5 Short-Term Effectiveness—The exposure risk to workers during soil excavation solidification of tank contents at TSF-09/18 could be significant, however radiation monitoring and control measures have been demonstrated to effectively mitigate risks in previous INEEL removal actions. Short-term effectiveness is therefore assessed as moderate. Equipment operator exposures would be minimized to the extent possible using established procedures. Supplied air and shielding in the form of leaded windows and lead lining on exterior facing surfaces of the equipment would be used as needed. Excavation equipment modified with positive-pressure ventilation system cabs and HEPA filters for use in radioactively-contaminated areas is available at the INEEL from previous remedial actions. If not available onsite, excavation equipment may be supplied by a subcontractor or may be purchased from vendors. However, modification of subcontractor or purchased equipment may be necessary for use in a radioactively-contaminated environment. The activities associated with removing these soils would require exposure to radioactive materials. The operator risk would be directly related to the time required to perform the excavation. Exposure and risk per operator could be decreased by increasing the number of equipment operators, and decreasing the time spent on site by any one person. Nonexposure risks to workers are also a consideration during excavation. These risks result primarily from physical construction hazards, such as vehicle accidents or personnel injuries. However, implementation of appropriate health and safety measures for the excavation activities can minimize these risks.

Environmental impacts resulting from this alternative are dependent on the remedial design and required access areas. The surrounding landscape would likely be disturbed because of the equipment and vehicles moving in and around the site. However, the impact of these activities would be temporary, and the entire site would be restored to match the surrounding landscape at the completion of the project. No environmentally sensitive archaeological or historical sites, wetlands, or critical habitat exist at the OU 1-10 sites.

RAOs would be achieved by this alternative once excavation and disposal at the on-site location is complete. Per DOE Order 5820.2A requirements during implementation of this alternative, exposures to equipment operators must be reduced below 25 mrem/yr.

12.8.3.1.6 **Implementability**—This alternative is technically feasible and has a moderate administrative feasibility. There are no site-specific conditions that exist at TSF-09/18 that would provide significant difficulty associated with soil excavation or transportation of soils to the proposed ER INEEL soil repository for disposal. Personnel, equipment and services associated with the soil excavation and grout injection of tanks are readily available. Long-term monitoring of the site would be required to verify the effectiveness of the in-place treatment of the tank contents. Implementation of this alternative would be moderately difficult because of the complexity of the retrieval system with respect to safety consideration and on-site containment requirements. Significant effort would be required to perform environmental assessments, safety analyses, permit preparation, and equipment modifications.

12.8.3.1.7 **Cost**—The costs associated with Alternative 3a include excavation of radionuclide-contaminated soils at TSF-09/18, in-place solidification of tank contents, and on-site transport and disposal of soils at the proposed ER INEEL soil repository. The estimated NPV for each subsite is shown in Table 12-32. The alternative cost estimates are for comparison purposes only and not intended for budgetary, planning, or funding purposes.

12.8.3.2 Alternative 3b: Soil Excavation, In Situ Treatment of Tank Contents, and Off-site Soil Disposal. Alternative 3b would consist of soil excavation, grouting tank contents in-place, and transportation of the excavated soils off-site to a commercial low-level radioactive waste disposal facility. Contaminated soils surrounding the tanks would be excavated using standard construction equipment. Tank contents would be grouted in place by mixing the tank contents and injecting grout into the tanks through existing sample ports. During excavation activities, all uncontaminated soils would be stockpiled on site and replaced into the excavated area following removal of radionuclide-contaminated soil. Excavated soils would be transported to a commercial low-level radioactive waste disposal facility. Compliance with appropriate waste characterization and transportation requirements imposed by the facility would be required under this alternative. Verification sampling would be conducted to ensure that all contamination present at concentrations exceeding PRGs was removed. The excavated areas would be backfilled with clean soils after excavation and revegetated to natural conditions. Environmental monitoring to confirm no contaminant migration from the tank area would be conducted following completion of the remedial action. This monitoring may consist of the placement of boreholes and/or monitoring wells through the treated waste form to the underlying soils. In addition, five-year site reviews would be conducted to evaluate the effectiveness of the institutional controls and the need for further environmental monitoring, or additional control measures as applicable. Five-year site reviews would be conducted for a 100-year period. Implementation of this alternative likely prevents return of this site to unrestricted use; however treated tank contents will be at depths greater than 10 feet.

Table 12-32. Alternative 3a: NPV for TSF-09/18.

Site	NPV ($)
TSF-09/18 (V-1, V-2, V-3, and V-9)	4,991,306

Conventional excavation and transportation equipment and procedures would be used under this alternative. Supplied air and shielding in the form of leaded windows and lead lining on exterior facing surfaces of the equipment would be used as needed. Excavation equipment modified with positive-pressure ventilation system cabs and HEPA filters for use in radioactively-contaminated areas is available at the INEEL from previous remedial actions. If not available onsite, excavation equipment may be supplied by a subcontractor or may be purchased from vendors. However, modification of subcontractor or purchased equipment may be necessary for use in a radioactively-contaminated environment.

At TSF-09/18, the estimated footprint of radionuclide-contaminated soils would be excavated (approximately 80 by 50 ft) to a depth of 20 ft. The contents of the tanks would be solidified in place by mixing the tank contents and injecting grout into existing openings in the tanks and filling the tanks to their respective capacity. An off gas collection would be established to collect the vapors that would escape from the tank during the grouting process.

12.8.3.2.1 Overall Protection of Human Health and the Environment—Under this alternative, human health and environmental risks and would be reduced by preventing direct exposure to tank contents and radionuclides in soils at TSF-09/18. Removal of radionuclide-contaminated soil and in-place treatment of tank contents would provide long-term protection form direct exposure and contaminant migration. Therefore, this alternative meets specified RAOs and provides for overall protection of human health and the environment at TSF-09/18.

12.8.3.2.2 Compliance with ARARs and TBCs—Table 12-1 presents the evaluation of this alternative for compliance with the ARARs and TBCs. IDAPA 16.01.01650, 16.01.01161, and Air Toxics Rules applies to TSF-09/18 if it was a source of fugitive dust and are ARARs that would be met by performing excavation using water sprays and other techniques for dust suppression. 40 CFR 122.26, which regulates stormwater and associated discharges would be met through engineering controls of surface water runoff. Hazardous waste rules would most likely apply to the treated tank contents and would be met through proper treatment methods. In addition, soils and residues must be disposed of in accordance with the land disposal restrictions, 40 CFR 268. If the tank contents are determined to contain PCBs over 50 ppm, compliance with TSCA regulations will also be required. This alternative would meet all ARARs and TBCs through proper waste management techniques, with the exception of TSCA regulations which may required waivers (see footnote, Table 12-1). DOE Orders would be met because health risks to current and future workers and potential residents would be within allowable ranges.

12.8.3.2.3 Long-Term Effectiveness and Permanence—This alternative provides for long-term and permanent prevention of human and environmental exposure to tank contents and radionuclide-contaminated soils at TSF-09/18. The long-term risk to human health and the environment is basically transferred from TSF-09/18 to the managed off-site disposal facilities. However, existing management practices at the disposal facilities would be continued to ensure minimal risks to human health and the environment. Because potential residential exposure to contaminants in soil and tank contents at and TSF-09/18 (V-1, V-2, V-3, and V-9) is prevented, the long-term effectiveness and permanence of Alternative 3a is considered high.

12.8.3.2.4 Reduction of Toxicity, Mobility, or Volume Through Treatment—Under this alternative no treatment is specified for radionuclide-contaminated soils. However, in situ treatment of tank contents in place via solidification is specified. Solidification of tank contents in place would likely result in a reduction of contaminant mobility. However, the solidification specified for tank contents would likely result in an increase in volume of contaminated media. The toxicity of the treated tank contents is likely to be relatively unaffected by solidification. Contaminant toxicity, mobility, and volume of the excavated soils would be eliminated from TSF-09/18. However, contaminant toxicity, mobility, and volume would basically be transferred to the off-site disposal location. Contaminant mobility of radionuclide-contaminated soils would be minimized at the off-site disposal location through effective waste management practices.

12.8.3.2.5 Short-Term Effectiveness—The exposure risk to workers during excavation and removal of contaminated soil and in situ treatment of tank contents at TSF-09/18 could be significant, however radiation monitoring and control measures have been demonstrated to effectively mitigate risks in previous INEEL removal actions. Short-term effectiveness is therefore assessed as moderate. Equipment operator exposures would be minimized to the extent possible using established procedures. Supplied air and shielding in the form of leaded windows and lead lining on exterior facing surfaces of the equipment would be used as needed. Excavation equipment modified with positive-pressure ventilation system cabs and HEPA filters for use in radioactively-contaminated areas is available at the INEEL from previous remedial actions. If not available onsite, excavation equipment may be supplied by a subcontractor or may be purchased from vendors. However, modification of subcontractor or purchased equipment may be necessary for use in a radioactively-contaminated environment. The activities associated with removing these soils would require exposure to radioactive materials. The operator risk would be directly related to the time required to perform the excavation. Exposure and risk per operator could be decreased by increasing the number of equipment operators, and decreasing the time spent on site by any one person.

Nonexposure risks to workers are also a consideration during excavation. These risks result primarily from physical construction hazards, such as vehicle accidents or personnel injuries. However, implementation of appropriate health and safety measures for the excavation activities can minimize these risks.

Environmental impacts resulting from this alternative are dependent on the remedial design and required access areas. The surrounding landscape would likely be disturbed because of the equipment and vehicles moving in and around the site. However, the impact of these activities would be temporary, and the entire site would be restored to match the surrounding landscape at the completion of the project. No environmentally sensitive archaeological or historical sites, wetlands, or critical habitat exist at the OU 1-10 sites.

RAOs would be achieved by this alternative once excavation and disposal at the on-site location is complete. Per DOE Order 5820.2A requirements during implementation of this alternative, exposures to equipment operators must be reduced below 25 mrem/yr.

12.8.3.2.6 Implementability— This alternative is technically feasible and has a moderate administrative feasibility. There are no site-specific conditions that exist at TSF-09/18 that would provide significant difficulty associated with in situ treatment of tank contents, soil excavation, or transportation of soils to the off-site disposal facility. Personnel, equipment, and services associated with the soil excavation and grout injection of tanks are readily available. Long-term monitoring of the site would be required to verify the effectiveness of the in-place treatment of the tank contents. Implementation of this alternative would be moderately difficult because of the complexity of the retrieval system with respect to safety consideration and off-site containment requirements. Significant effort would be required to perform environmental assessments, safety analyses, permit preparation, and equipment modifications (for operator safety), as well as system testing and demonstration. Off-site transportation of contaminated materials presents potential administrative constraints due to potential exposures to human receptors between INEEL and the disposal facility. Coordination would be required between INEEL and disposal facility personnel to ensure disposal criteria are met before contaminated materials are excavated for off-site transport.

12.8.3.2.7 Cost—The costs associated with Alternative 3b include excavation of radionuclide-contaminated soils at TSF-09/18, in-place solidification of tank contents, and off-site transport and disposal of soils at an off-site facility for treatment and disposal, backfilling of excavated areas, and grading and revegetating the sites to natural conditions. The estimated NPV for this subsite is shown in Table 12-33. The alternative cost estimates are for comparison purposes only and are not intended for budgetary, planning, or funding purposes.

12.8.3.3 Alternative 4: In Situ Vitrification of Tank Contents and Soils Within the Treatment Area. The in-situ vitrification of tank contents alternative was developed to address contaminated soils and tank waste at TSF-09/18 (V-1, V-2, V-3 and V-9). Alternative 4 would consist of vitrifying the tank contents and contaminated soils within the treatment area in-place. Contaminated soils would be incorporated into the melt and would not require excavation, transport, or disposal. Vitrification would be accomplished by establishing two planar shaped melts on opposite sides of the tanks which grow together and process the tank and its contents along with the surrounding soil as melting progresses. The treatment area would be backfilled with clean soils as necessary to bring it to grade and revegetated to natural conditions. Environmental monitoring would be conducted following completion of the remedial action to confirm that no contaminant migration from the treatment area is occurring. This monitoring may consist of the placement of the boreholes and/or monitoring wells through the treated waste form to the underlying soils. In addition, five-year site reviews would be conducted to evaluate the effectiveness of the institutional controls and the need for further environmental monitoring, or additional control measures as applicable. Five-year site reviews would be conducted for a 100 year period. Implementation of this alternative likely prevents return of this site to unrestricted use; however treated tank contents will be at depths greater than 10 feet.

A cold test (i.e., mock-up simulation of the V-9 tank and contents) will be performed to obtain the information to support the remedial design. Following a successful cold test, the actual V-9 tank will be processed, followed by V-1, V-2, and V-3. Equipment to conduct the cold test and actual vitrification would be supplied by a subcontractor and is assumed to be appropriately modified to perform in a radiologically contaminated environment. Site preparation includes grading and leveling of the north of the TSF-09/18 tanks, providing adequate power to the site (i.e., 12.8 or 13.2 KVA). Additionally, it is assumed that the in situ vitrification system will require an off gas treatment system to treat contaminated vapors produced by the vitrification process, but that it will not require secondary containment or weatherproof enclosure.

In situ vitrification of the V-1, V-2, V-3, and V-9 tank contents and contaminated soils will be processed by individual melts. The soils above surrounding the tanks will be vitrified along with the tank contents.

12.8.3.3.1 Overall Protection of Human Health and the Environment—Under this alternative, human health and environmental risks would be reduced by preventing direct exposure to radionuclides in soils and preventing the potential direct exposure or release of the tank contents. In-place treatment of contaminated soil and tank contents would provide long-term protection from direct exposure

Table 12-33. Alternative 3b: NPV for TSF-09/18, Soil Excavation, In Situ Treatment of Tank Contents, and Off-Site Treatment/Disposal.

Site	NPV ($)
TSF-09/18	5,794,928

and contaminant migration. Therefore, this alternative meets specified RAOs and provides for overall protection of human health and the environment at TSF-26.

12.8.3.3.2 Compliance with ARARs and TBCs—Table 12-1 presents the evaluation of this alternative for compliance with the ARARs and TBCs. IDAPA 16.01.01650, 16.01.01161, and Air Toxics Rules applies to TSF-09/18 if they were a source of fugitive dust and are ARARs that would be met by performing excavation using water sprays and other techniques for dust suppression. Air Toxics Rules also apply to the off-gas treatment system to treat gas generated from the vitrification process. 40 CFR 122.26, which regulates stormwater and associated discharges would be met through engineering controls of surface water runoff. Hazardous waste rules would most likely apply to the treated tank contents and would be met through proper treatment and disposal methods. In addition, the waste and residues must be disposed of in accordance with the land disposal restrictions, 40 CFR 268. If the tank contents are determined to contain PCBs over 50 ppm, compliance with TSCA regulations will also be required. This alternative would meet all ARARs and TBCs through proper waste management techniques. DOE Orders would be met because health risks to current and future workers and potential residents would be within allowable ranges.

12.8.3.3.3 Long-Term Effectiveness and Permanence—This alternative provides for long-term and permanent prevention of a release of the tank contents to the environment thereby mitigating the potential for human and environmental exposure to the tank contents. Because the radionuclide-contaminated soils are treated along with the tank contents, the long-term risk to human health and the environment from radionuclide-contaminated soils is reduced. Because potential residential exposure to contaminants in soil and tank contents at TSF-09/18 is considered unlikely although not prevented, the long-term effectiveness and permanence of Alternative 4 is considered medium.

12.8.3.3.4 Reduction of Toxicity, Mobility, or Volume Through Treatment— In situ treatment of tank contents and radionuclide-contaminated soil via vitrification is specified. In situ vitrification of tank contents and soil would likely result in a reduction of contaminant mobility. Additionally, a volume reduction would likely be realized due to removal of intergranular voids in the tanks and surrounding soils. The toxicity of the treated tank contents and soil is likely to be relatively unaffected by vitrification.

12.8.3.3.5 Short-Term Effectiveness—The exposure risk to workers during in situ vitrification could be significant; however because the soil and tank wastes are not directly handled and radiation monitoring and control measures have been demonstrated to effectively mitigate risks, the short-term effectiveness is therefore assessed as moderate. Worker exposures to radionuclide-contaminated soils during site preparation and mobilization would be minimized to the extent possible using established procedures. The worker risk would be directly related to the time required to perform such activities.. Exposure and risk per worker could be decreased by decreasing the time spent on site by any one person.

Nonexposure risks to workers are also a consideration during site preparation and treatment activities. These risks result primarily from physical construction hazards, such as vehicle accidents or personnel injuries. However, implementation of appropriate health and safety measures for the excavation and treatment activities can minimize these risks.

Environmental impacts resulting from this alternative are dependent on the remedial design and required access areas. The surrounding landscape would likely be disturbed because of the equipment and vehicles moving in and around the site. However, the impact of these activities would be temporary, and the entire site would be restored to match the surrounding landscape at the completion of the project. No environmentally sensitive archaeological or historical sites, wetlands, or critical habitat exist at the OU 1-10 sites.

RAOs would be achieved by this alternative once treatment is complete. To satisfy DOE requirements during implementation of this alternative, exposures to workers must be reduced below 25 mrem/yr.

***12.8.3.3.6* Implementability**—This alternative is technically feasible and has a moderate administrative feasibility. There are no site-specific conditions that exist at TSF-09/18 that would provide significant difficulty associated with the treatment. Personnel, equipment and services associated with the treatment will be readily available or provided by a subcontractor. One melt per tank is anticipated and an off-gas system will be used to recover and treat emissions generated from the treatment process. Long-term monitoring of the site would be required to verify the effectiveness of the vitrification process. Implementation of this alternative would be moderately difficult because of the complexity of the treatment system. Significant effort would be required to perform the necessary cold test(s), environmental assessments, safety analyses, permit preparation, and remedial design.

12.8.3.3.7 Cost—The costs associated with Alternative 4 include cold test (s) at the subcontractor site to support the remedial design of the process for this application, demonstration that regulatory cleanup standards are met, preparation of the necessary planning documents, obtaining necessary work approvals and permits, pretreatment of tank contents, and in situ vitrification of tank contents. The estimated NPV for is shown in Table 12-34. The alternative cost estimates are for comparison purposes only and not intended for budgetary, planning, or funding purposes.

12.8.4 Summary of Individual Analysis for TSF-09/18

Detailed analysis of TSF-09/18 alternatives will be performed when the results of the treatability study are available.

12.9 Comparative Analysis for V-Tank Treatment Options

The treatment configurations, as graphically shown in Section 11.4 were considered for managing the wastes located in V-1, V-2 and V-3. All the configurations are judged to be equal with their ability to:

1. Protect human health and the environment

2. Comply with ARARs

Therefore, the five treatment configurations were only analyzed with regards to:

1. Provide long-term effectiveness and permanence.

2. Reduction of toxicity, mobility or volume

Table 12-34. Alternative 4: NPV for TSF-09/18.

Site	NPV ($)
TSF-09/18 (V-, V-2, V-3, and V-4)	10,471,864

3. Short-term effectiveness

4. Implementability

5. Cost.

12.9.1 Long-Term Effectiveness and Permanence

Alternatives 2a and 2b provide the highest degree of long-term effectiveness and permanence for contaminated soils and tank contents at TSF-09/18, because contaminated soil, tanks, and tank contents are removed from the site, tanks and tank contents are treated and placed in a managed disposal unit. Alternatives 3a and 3b are the next highest ranked alternatives with respect to long-term effectiveness and permanence. These alternatives are lower ranked than Alternative 2A and 2B because they do not involve removal of the tanks themselves. Alternative 4 is lower ranked that Alternative 2a and 2b because it does not involve removal of the tank contents or contaminated soil, but are treated together. Alternative 4 potential residential exposure to contaminants in soil and tank contents is considered unlikely rather than being prevented.

12.9.2 Reduction of Toxicity, Mobility, or Volume Reduction Comparison

The six treatment strategies were evaluated for the criteria listed in section 12.1.4. Exclusive Solidification is the lowest ranking alternative for this category. Although the technology will immobilize the contaminants and is considered to be irreversible, it will not reduce the waste toxicity. In addition, solidification increases the final waste volume.

The next lowest treatment alternative for this category is the On-Site Combined Technology. This process will not reduce toxicity. However, in addition to immobilizing the waste, it reduces the final waste volume by removing some of the water prior to solidification.

The highest ranking alternative is thermal treatment. In addition to waste immobilization, this strategy reduces the toxicity by destroying the volatile organic compounds (VOCs) and has maximum waste volume reduction by removing all the water during treatment. However, the final waste is still toxic due to the nonvolatile RCRA metals and radionuclides which remain in the product.

12.9.3 Short-Term Effectiveness Comparison

The treatment strategies were evaluated for the criteria listed in Section 12.1.5.

The exposure risk to workers during waste removal and treatment could be significant but, as demonstrated in previous INEEL remediation actions, radiation/chemical monitoring and control measures will mitigate these risks. The highest exposure risk to workers is Options 2a4, 2a5. and 4. These treatment configuration, has the most equipment requiring operator attendance and maintenance. In addition, this is not a fixed facility equipped with permanent radiological and chemical protective features such as Option 2a3.

The next lowest treatment alternative for worker exposure is Options 2a1, 2a2, 3a, and 3. Although it has less equipment than the Options 2a4, 2a5 and 4, it is envisioned that these will be performed on-site using temporary, mobile facilities.

Alternative 2a, Option 2a3 and Alternative 2b offers the greatest protection to the workers for reasons listed above.

Environmental impacts depend upon the footprint required for the treatment process and the necessary access area. The surrounding landscape could be disturbed, however, the impacts are considered temporary. The site would be restored to match surrounding landscape at the completion of the project.

12.9.4 Implementability Comparison

All alternatives considered for V-Tank treatment are technically feasible and have moderate to difficult administrative feasibility's.

Alternative 2a, Options 2a4 and 2a5 and Alternative 4 have the lowest implementability ranking due to the complexity of the process when compared to the other strategies. Its ability to produce a consistent waste volume reduction and to monitor its effectiveness is considered to be difficult. The necessary approvals and permits are greatest for this alternative.

The next lowest treatment alternative for implementability Alternative 2a, Option 2a3. It is unknown when on-site treatment of TSCA waste will be available. With respect to Alternative 2b, the logistics for shipping liquid mixed waste to ORNL are complex and currently the facility is under a self-imposed moratorium from receiving out-of-state wastes.

The highest ranking alternative for implementability is Alternative 2a, Options 2a1 and 2a2 and 3a and 3b. These alternative and treatment options are a relatively simple processes and can be performed at the INEEL with the fewest administrative approvals and permits.

12.9.5 Cost

Each alternative and associated options (8 total) were evaluated. The general assumptions and methodology used to develop the waste treatment costs are located in the Appendix. The cost estimates are for comparison purposes only and are not intended for budgetary, planning or funding purposes. The NPV estimated for each have an accuracy of +50 % to –30% in accordance to CERCLA guidance. The NPV for the eight options are listed below in Table 12-35.

12.9.6 Comparison Summary for the Treatment Alternatives

Table 12-36 is a summary of the comparative analysis for the treatment processes considered for the V-Tank contents. Relative rankings were assigned to each alternative based on the various evaluation criteria. A value of "+" indicates a favorable ranking relative to other alternatives for that criteria. A value of "0" indicates a neutral relative ranking and a value of "–" indicates an unfavorable ranking relative to other alternatives.

Table 12-35. Comparison of NPV for the options considered feasible to treat the V-tank waste.

Alternative/option	NPV U.S $	Comments
2a5—On-Site Combined Technology using Evaporation	13,756,389	—
2a4—On-Site Combined Technology using Reverse Osmosis	13,273,841	—
2a1—Ex-situ Solidification/Stabilization without Solid/Liquid Separation	12,806,806	—
4—In situ Vitrification	10,471,864	—
2a2—Ex-situ Solidification/Stabilization with Solid/Liquid Separation	9,915,003	Expensive to dispose waste due to significant increase in waste volume
2b—Thermal Treatment at ORNL	8,045,582	—
2a3—Thermal Treatment at INEEL	7,668,701	—
3b—In situ Treatment (Grouting) and Off-Site Soil Disposal	6,669,536	—
3a—In situ Treatment (Grouting and On-site Soil Disposal	4,158,023	Least expensive alternative considered

Table 12-36. Comparison Summary for V-Tank Contents Treatment Alternatives.

Criterion	Alternative 2a, Option 2a1: Solidify/ Stabilize Contents Without Solid/Liquid Separation	Alternative 2a, Option 2a2: Solidify/ Stabilize Contents With Solid/Liquid Separation	Alternative 2a, Option 2a3: Storage of Tank Wastes at RWMC, Thermal Treatment at the INEEL, and Disposal at RWMC	Alternative 2b: Tank Wastes Transported to ORNL, Thermal Treatment at ORNL, and Disposal at RWMC	Alternative 2a, Option 2a4: Solid/Liquid Separation, Liquid Treatment by Reverse Osmosis, Solidification or Stabilization of Solids	Alternative 2a, Option 2a5: Solid/Liquid Separation, Liquid Treatment by Evaporation/Carbon Absorption, Solidification or Stabilization of Solids	Alternative 3a	Alternative 3b	Alternative 4
Reduction of Toxicity, Mobility, or Volume	–	–	+	+	0	0	–	–	–
Short-term Effectiveness	0	0	+	+	–	–	0	0	–
Implement-ability	+	+	0	0	–	–	+	+	–
Cost	–	O	+	o	–	–	+	+	0

+ Favorable relative ranking

0 Neutral relative ranking

– Unfavorable relative ranking

12.10 References

EPA, 1988, *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA*, EPA/540/G-89/004, Interim Final, U.S. Environmental Protection Agency, Office of Emergency and Remedial Response, October.